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REPORT

OF THE

SECRETARY OF WAR

BEING PART OF

THE MESSAGE AND DOCUMENTS

COMMUNICATED TO THE

TWO HOUSES OF CONGRESS

AT THE

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IMPROVEMENTS.—Great Kanawha River, W. Va., 1951; operating and care of locks and dams on Great Kanawha River, W. Va., 1962; Elk River, W. Va., 1963; Gauley River, W. Va., 1964; New River, Va. and W. Va., 1965.

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ANNUAL REPORT

OF THE

CHIEF OF ENGINEERS,

UNITED STATES ARMY.

1894.

REPORT

OF

THE CHIEF OF ENGINEERS,

UNITED STATES ARMY.

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., September 29, 1894.

SIR: I have the honor to present for your information the following report upon the duties and operations of the Engineer Department for the fiscal year ending June 30, 1894:

OFFICERS OF THE CORPS OF ENGINEERS.

The number of officers holding commissions in the Corps of Engineers, U. S. Army, at the end of the fiscal year was 120.

Since the last annual report the Corps has lost one of its officers, Capt. Henry S. Taber, who died at San Antonio, Tex., April 12, 1894.

On the 30th of June, 1894, the officers were distributed as follows:

Commanding the Corps of Engineers and the Engineer Department	1
Office of the Chief of Engineers and Light-House Board	1
Office of the Chief of Engineers	2
Board of Engineers, fortifications, river and harbor works, California Débris Commission, and Division Engineer	1
Board of Engineers, Board of Ordnance and Fortification, and Division Engineer	1
Board of Engineers, fortifications, river and harbor works, and Division Engineer	1
Board of Engineers, Mississippi River Commission, Division Engineer, and Board of Visitors	1
River and harbor works and Division Engineer	1
Washington Aqueduct	1
Board of Engineers, fortifications, river and harbor works, and Board of Visitors	2
Public buildings and grounds and Light-House Board	1
Fortifications and river and harbor works	23
Mississippi River Commission, Missouri River Commission, and light-house districts	1
River and harbor works and light-house district	1
Fortifications, post of Willets Point, U. S. Engineer School, and Battalion of Engineers	1
Fortifications, river and harbor works, and California Débris Commission	1
Mississippi River Commission, river and harbor works, and light-house district	1
Missouri River Commission and river and harbor works	2
River and harbor works and Yellowstone National Park	1
River and harbor works	32
Fortifications, river and harbor works, and light-house districts	3

River and harbor works, California Débris Commission, and light-house district	1
River and harbor works, Columbian Exposition, and engineer officer, department of the Missouri	1
Battalion of Engineers and U. S. Engineer School	14
Mississippi River Commission	1
California Débris Commission	1
Missouri River Commission	1
Special Subcommittee on Appropriations, House of Representatives, and public buildings and grounds	1
Leave of absence	2
Detached, on International Boundary Commission, at Military Academy, with Light-House Establishment, as military attachés, and with Board of Commissioners of the District of Columbia	19
	120

The officers detached were on duty as follows:

Lieut. Col. John W. Barlow and Lieut. David DuB. Gaillard, members of International Boundary Commission	2
Maj. Oswald H. Ernst, Superintendent Military Academy	1
Maj. David P. Heap, engineer Third light-house district	1
Maj. William Ludlow, military attaché to the U. S. embassy at London	1
Maj. Milton B. Adams, engineer Ninth and Eleventh light-house districts	1
Maj. William R. Livermore, engineer First and Second light-house districts	1
Capt. Charles F. Powell, Engineer Commissioner of the District of Columbia	1
Capt. Philip M. Price, engineer secretary of the Light-House Board	1
Capt. Eric Bergland, engineer Fifth and Sixth light-house districts	1
Capts. George McC. Derby and Gustav J. Fiebeger, assistants to the Engineer Commissioner of the District of Columbia	2
Capt. James L. Lusk and Lieuts. Mason M. Patrick and Charles S. Bromwell, on duty with Company E, Battalion of Engineers, and at Military Academy	3
Capt. Theodore A. Bingham, military attaché to the U. S. embassy at Rome	1
Lieuts. Joseph E. Kuhn, Henry C. Newcomer, and Thomas H. Rees, on duty at Military Academy	3
	19

The above table shows that 45 officers of the corps are on detached duty or are not engaged in immediate connection with river and harbor works, and that of the 75 engaged on this class of works 38 have additional duties of other characters.

Of the five companies comprising the Batallion of Engineers one exists on paper only. Should this company be given its legal quota of men, as is recommended later in this report, at least three officers should be attached to it.

The public works to be carried on under the supervision of the Chief of Engineers are steadily increasing, but the number of officers available for assignment to the execution of these works is decreasing, owing to the number detached for various duties assigned by law.

When an officer is to be detailed for such detached duty; when sickness necessitates the temporary relief of an officer; when new and additional duties are to be assigned, it is growing more and more difficult to meet the demands. More officers are needed; and while I do not now suggest the number of officers by which the Corps of Engineers should be increased, I believe an increase to be an imperative necessity.

FORTIFICATIONS.

Under a provision of an act of Congress approved March 3, 1885, a board was appointed by the President to examine and report at what ports fortifications or other defenses were most urgently required and the kind of defenses best adapted to each, with reference to armament. The result was the report of the Board on Fortifications or other Defenses, which was transmitted to Congress January 23, 1886. In this is to be found a list, in which are enumerated 27 ports, arranged in order of urgency; also, an estimate for the land defenses of these ports. This estimate covers the cost of armor, structural metal, and masonry and earth. It was estimated that the cost of the masonry and earth of these defenses would be $31,863,000. The amount of this estimate is given only to invite attention to its inadequacy to the work for which made.

For sixteen years, from 1874 to 1890, no appropriations were made for these defenses. There was good reason for this for the earlier part of this period, when it was not possible to say what would be the end attained in the development of the naval ordnance, and hence what the amount of cover required for defenses against projectiles. But early in the year 1890 it was realized that the time was opportune for drawing up projects for the defenses of our seacoast, and these have been prepared for fifteen of our ports and have received the approval of the Secretary of War. The study of projects for the defenses of Puget Sound, of Portland, Oreg., and of San Diego, are also under way, though the former was not enumerated in the list of the board above mentioned. The board, however, stated that it did not wish it to be understood that there were no other places along the coast which were of the importance necessary to justify measures of defense.

In the execution of the projects already prepared for fifteen ports, the following has been accomplished: The construction of emplacements has commenced at six of these and has recently been initiated at two more. One 12-inch rifle is now mounted and it is expected that this fall a second will be, in a completed battery for the defense of New York Harbor. Each of these guns is mounted on a lift, by which the gun may be completely lowered for loading out of sight of an enemy in twenty-six seconds, and the loaded gun raised for firing in twenty-one seconds; and the ammunition may be raised by another lift in seventeen seconds. The weight of gun and carriage thus lowered and raised is about 108 tons. A battery of 16 mortars is nearly ready for the defense of this harbor, and another for the defense of San Francisco Harbor. Before the close of the present fiscal year these batteries will be entirely ready; also one for the defense of Boston Harbor, and a second for that of New York Harbor; and three 12-inch rifles will probably be mounted en barbette on high sites of San Francisco Harbor. The completion of emplacements for seventeen 10-inch and 8-inch guns, to be mounted on disappearing carriages, is delayed by want of carriages on which to mount the guns, and that of seven emplacements for 12-inch and 10-inch guns is likely to be delayed for the same reason this fiscal year. It is hoped and urged that appropriations may be made for the manufacture of the disappearing carriage which has been invented by the Ordnance Department and has proved itself, from the very first, equal to all the requirements which such a carriage must fulfill. Guns on hand and emplacements awaiting their platforms, but delayed by reason of lack of carriages, are certainly strong grounds for appropriations for these carriages.

Appropriations for batteries and their platforms have been made in amounts, and by acts of Congress approved, as follows:

August 18, 1890	$1,221,000
February 24, 1891	750,000
July 23, 1892	500,000
February 18, 1893	50,000
August 1, 1894	500,000
	3,021,000

From these appropriations allotments have been made for emplacements and at places as follows:

Places.	12-inch guns.		On disappearing carriages.		12-inch mortars.
	On lifts.	On nondisappearing carriages.	10-inch guns.	8-inch guns.	
Portland, Me			*2		
Boston, Mass			*4		†16
New York, N. Y	†2		*3	*5	†32
Philadelphia, Pa	3				
Washington, D. C			*2		
Hampton Roads, Va			*3		
Pensacola, Fla			2		
San Francisco, Cal		‡5	*3		†16
Total	5	5	19	5	64

* Awaiting carriages by the end of this fiscal year.
† To be completed, with guns and mortars mounted, this fiscal year.
‡ Three guns to be mounted this fiscal year.

To prevent an enemy's fleet from running by the defenses to be constructed, it must be obstructed in its passage and thus held under fire of guns. Submarine mines constitute the form of obstruction adopted, and these are operated from mining casemates, which are proof against projectiles. The mines are connected to the operating apparatus in these casemates by cables, which traverse so-called cable galleries. In the year 1888 renewed attention was given to the construction of these casemates and galleries. In that and the three following years $482,581.08 was appropriated for this work. A balance of $5,509.94 remains unallotted, and a small appropriation is recommended for this work and another for the purchase of mining outfit. With the funds appropriated since 1888, twenty-six mining casemates and their galleries have been commenced at the harbors of Portland, Me., Boston, Narragansett Bay, New York, Philadelphia, Baltimore, Washington, Hampton Roads, Wilmington, N. C., Charleston, S. C., Savannah, Pensacola, and San Francisco. Of these, twenty are ready for occupation, but the outfit of cable, mines, etc., is not complete.

It must not be assumed that these mines will make guns and mortars unnecessary.

> Heavy batteries and submarine mines are correlative terms of a good defense from shore. Without powerful guns in the defense the armored ships of the enemy would proceed deliberately to the removal of the mines, either ignoring or silencing the fire of the works, and without the aid of the mines the enemy's vessels could not generally be prevented from running past the batteries.*

Details of the progress made under the various allotments for construction of gun and mortar batteries and of mining casemates during the past fiscal year will now be given.

Portland Harbor, Maine.—Officer in charge, Lieut. Col. P. C. Hains, Corps of Engineers.

The approved project for the defense of this harbor contemplates, for the present, an armament of eighteen 12-inch guns on lifts, ten 10-inch and ten 8-inch guns on disappearing carriages, forty-eight 12-inch mortars, and submarine mines to be operated from four mining casemates; one mining casemate is completed.

Under an allotment of $110,000, from the appropriation of July 23, 1892, the construction of emplacements for two 10-inch guns was commenced early in April, 1893, and continued during the entire season until December, when work had to be stopped for the winter.

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* Report of the Board on Fortifications or Other Defenses, 1886.

The excavation for the magazines and roadway in rear of the battery, which were in progress at the beginning of the fiscal year, was continued and the concreting began in August. The magazines for both emplacements were completed as far as they can be until the adoption of a service disappearing carriage. Considerable of the concrete mass in front of the south emplacement has been put in. In all about 4,088 cubic yards of concrete was laid, at an actual cost for labor and material of about $4.95 per cubic yard. The sand cost $1.40 per cubic yard, the cement $1.15 per barrel, the remainder of the cost being made up by cost of labor and of stone, which had to be quarried and crushed at the site.

Work on these emplacements was resumed this season in April.

Under an allotment made in April, 1893, the construction of two mining casemates and cable galleries was commenced June 1, 1893.

Work was stopped, because of cold weather, late in November, 1893, and was resumed early in June, 1894. It is expected that both casemates and galleries will be completed during the present season.

Boston Harbor, Massachusetts.—Officer in charge, Lieut. Col. S. M. Mansfield, Corps of Engineers.

The approved project for the defense of this harbor contemplates, for the present, an armament of twelve 12-inch guns on lifts, fifteen 10-inch and five 8-inch guns on disappearing carriages, one hundred and twenty-eight 12-inch mortars, and submarine mines to be operated from four mining casemates. Two mining casemates have been completed.

Four emplacements for 10-inch guns have been commenced. No work has been done at one emplacement during the year; at a second, the masonry has been carried as far as can be until the adoption of a service carriage; at a third, the masonry is carried up to the level of the crown of the arches of the magazines. For these last two, nearly all of the sand and concrete stone which will be needed has been collected and stored. The masonry of the fourth emplacement is well advanced; the casemate of the rapid-fire gun opposite it was completed, and the new earth embankments of the emplacement have been essentially completed.

The embankments and sodding of a battery for sixteen mortars were essentially completed and one platform well advanced. The construction of a third mining casemate was commenced during the latter part of June, 1893, under an allotment of $27,000. The masonry of the casemate and its entrance gallery, and about 250 feet of the cable gallery, were completed. About 7,500 cubic yards of sand embankment was built.

Narragansett Bay, Rhode Island.—Officer in charge, Capt. W. H. Bixby, Corps of Engineers, with Second Lieut. W. W. Harts, Corps of Engineers, under his immediate orders; Division Engineer, Col. H. L. Abbot, Corps of Engineers.

The approved project for the defense of this bay contemplates an armament of ten 12-inch guns on lifts, six 10-inch and four 8-inch guns on disappearing carriages, eighty 12-inch mortars, and submarine mines to be operated from two mining casemates.

Funds were allotted September 21 and October 26, 1892, for the construction of the two mining casemates; one is now practically completed and the other is ready for the construction of its concrete walls.

New York Harbor, New York.—Officers of the Corps of Engineers in charge: Lieut. Col. H. M. Robert, with First Lieut. W. P. Craighill as assistant since November 20, 1893; Lieut. Col. G. L. Gillespie, with First Lieut. J. G. Warren as assistant until December 26, 1893, and Second Lieut. R. McGregor since that date; and Lieut. Col. W. R. King.

The projects for the defense of both the southern and eastern entrances to this harbor contemplate, for the present, an armament of twenty-one 12-inch guns on lifts, fifteen 10-inch and nine 8-inch guns on disappearing carriages, one hundred and seventy-six 12-inch mortars, and submarine mines operated from five mining casemates; all of the mining casemates are completed.

Lieut. Col. Robert reports little has been done to the four emplacements for 8-inch guns, the completion of which awaits the adoption of a gun carriage.

The fireproof storage building for submarine mining materials has been completed, except laying a concrete flooring, introducing machinery for handling the materials, and a few minor details. Details of the cost of this building are given in Appendix No. 1.

Lieut. Col. Gillespie reports as follows: The mechanism for the south-lift of gun-lift battery No. 1 for two 12-inch guns has been completed, erected, and tested with five service rounds with satisfactory results. The lift now awaits its carriage, which is expected to be delivered this autumn. The entrance doors have been hung and the arrangements for ammunition service completed. The mechanism of the lifts has been cared for during the year and operated from time to time.

The work of construction of the battery and its hydraulic mechanism is now completed, and the mounting of the second gun alone remains to make it ready for service.

At the close of the fiscal year the masonry and sand emplacement of the battery for sixteen 12-inch mortars was completed, and the paving of the north half of the battery was completed. The sixteen carriages were in place and thirteen of the sixteen mortars mounted thereon. The remaining three mortars are at the battery ready for mounting. All the slopes have been sown with grass seed.

Five experimental shots were fired from one of the mortars to test the mortar and to observe the effects on the slopes. The trial was satisfactory.

The total amount of masonry in the completed battery will be 29,931 cubic yards, and of sand, 150,345 cubic yards.

The torpedo shed is completed, and a large portion of the material required for the submarine mining defense is unpacked and stored.

During the year ending June 30, 1894, the following work was done on one emplacement for a 10-inch gun on disappearing carriage, its adjacent two magazines and two casemates for rapid-fire guns:

East magazine.—The excavation was made for the foundation of the magazine, entrance gallery and ammunition gallery leading to gun emplacement, and for passage leading to a casemate for rapid-fire guns. The masonry for the magazine and gallery walls and ceilings was completed, and the earth covering put on and sodding begun.

Second magazine.—The excavation for the foundation of the magazine and for the passage leading to second casemate for rapid-fire guns was completed. The masonry of the magazine and the passage is also practically completed.

The paving of magazines and galleries remains to be done, and a small portion of the superior slope of the second set of magazines. The grading and sodding of the slopes also remain to be done.

A plan for the drainage of the entire battery, of which this emplacement is part, has been prepared.

The total quantity of excavation to June 30, 1894, is 10,867 cubic yards, being the entire amount required for the two sets of magazines. This earth has all been used in the magazine covering and parapet of battery.

The total quantity of masonry in place is 10,362.4 cubic yards, at an average cost of $4.166 per cubic yard.

Further details of these works are given in Appendix No. 2.

Lieut. Col. King reports: The work on the three emplacements, two for 10-inch and one for an 8-inch gun, was continued, and now all are completed as far as they can be carried until a carriage is adopted. The work consisted chiefly in laying concrete, earth excavation, embankment, and sodding. While the quantities of concrete masonry placed and earth excavated are about the same as last year, the amount of earth embanked is about three times as great, and in addition to this all the sodding has been done this year, though the total expense this year was less than that of last year by $5,363.51. This is partly due to some of the materials used for concrete having been procured at a much lower rate than heretofore; for instance, broken granite has been delivered alongside the wharf for $1.18 per cubic yard.

The mortar battery under construction is so situated that it has been necessary to blast the magazines and mortar pits from solid rock, and this rock excavation has constituted an important item of the work. Only the entrances to the western pits remain to be excavated. The concrete work on magazines and passageways was continued. Sand for constructing embankments was brought from a distance, there being no surplus earth at the site. About half of the filling is completed. The work of constructing platforms for four mortars is well advanced, and the anchoring bolts are set. Three platforms are ready for the lower roller paths of the carriages. Four carriages are on hand.

Philadelphia, Pa.—In charge of Maj. C. W. Raymond, Corps of Engineers; Division Engineer, Col. H. L. Abbot, Corps of Engineers.

No work other than that of preservation and repair of fortifications was carried on. An act of Congress approved January 6, 1893, authorized the sale of land in the vicinity of Fort Mifflin, which is within the limits of the city of Philadelphia. The act authorized the Secretary of War and the Secretary of the Navy to sell, at such price as may be agreed upon by the Attorney-General and themselves, and convey to the International Navigation Company so much of certain land lying outside the dike or river bank eastward of the fort as would not, in the judgment of these officials, be prejudicial to the interests of the United States, the sale to be subject to such conditions as they should deem proper for the public interest.

A board, consisting of Maj. C. W. Raymond, Corps of Engineers; Civil Engineer C. C. Wolcott, U. S. Navy, and Col. Cecil Clay, chief clerk of the Department of Justice, was appointed to consider and report upon the price to be fixed for the land and the conditions of the sale and conveyance deemed proper to protect the public interest.

The board recommended that the deed conveying the land shall contain a clause reserving to the United States the right to erect, maintain, and control dikes or other works of improvement upon the property; to remove the same, and to occupy and use so much of the property as may be necessary for these purposes at all times; and also a clause prohibiting the occupation of the property in any manner or by anything which may be in any way dangerous, deleterious, or damaging to any other property of the United States, whether adjoining that conveyed or in its vicinity; and that the sum of $16,000 be fixed as the price to be paid for the land to be sold.

The report of the board is to be found in Appendix No. 3.

Washington, D. C.—In charge of Maj. C. E. L. B. Davis, Corps of Engineers, with First Lieut. G. A. Zinn, Corps of Engineers, under his immediate orders until May 4, 1894; Division Engineer, Col. W. P. Craighill, Corps of Engineers.

The approved project of defense contemplates emplacements for four 12-inch guns on lifts, six 10-inch and three 8-inch guns on disappearing carriages, eight 12-inch mortars, and submarine mines operated from two mining casements, of which one is completed.

The construction of emplacements for two 10-inch guns was continued until the latter part of September, 1893, when it had been completed as far as it was possible until the carriages for the guns are decided upon.

Hampton Roads, Virginia.—In charge of Maj. C. E. L. B. Davis, Corps of Engineers, with First Lieut. G. A. Zinn, Corps of Engineers, under his immediate orders until May 4, 1894; Division Engineer, Col. W. P. Craighill, Corps of Engineers.

The approved project of defense contemplates, for the present, five 12-inch guns on lifts, ten 10-inch guns on disappearing carriages, thirty-two 12-inch mortars, and submarine mines operated from two mining casemates, of which one is completed. Emplacements for three 10-inch guns have been completed as far as can be done until the carriages to be used are decided upon.

Savannah, Ga.—In charge of Capt. O. M. Carter, Corps of Engineers; Division Engineer, Col. W. P. Craighill, Corps of Engineers.

Funds were allotted February 20, 1894, for the construction of one mining casemate, which is now in progress.

Pensacola, Fla.—In charge of Capt. P. M. Price, Corps of Engineers, until March 3, 1894, and after that date in charge of Capt. F. A. Mahan, Corps of Engineers; Division Engineer, Col. C. B. Comstock, Corps of Engineers.

Funds for one mining casemate were allotted August 28, 1893. The work was commenced and completed during the year; its cost was $8,012.39.

San Francisco Harbor, California.—Officers in charge, Col. G. H. Mendell, with Second Lieut. C. A. F. Flagler under his immediate orders, and Lieut. Col. W. H. H. Benyaurd, with First Lieut. C. L. Potter under his immediate orders, all officers of the Corps of Engineers.

The approved project of defense contemplates, for the present, eighteen 12-inch guns on lifts, twenty-three 10-inch and thirteen 8-inch guns on disappearing carriages, fifteen 12-inch, five 10-inch, and six 8-inch guns on nondisappearing carriages, one hundred and forty-four 12-inch mortars, and submarine mines operated from seven mining casemates.

Two mining casemates are completed, and two, while incomplete, can readily be completed while in use.

Col. Mendell has charge of the construction of emplacements for three 10-inch guns on disappearing carriages and for three 12-inch guns on nondisappearing carriages, and of a battery for sixteen 12-inch mortars.

The emplacements are as yet unfinished, though it is expected that two platforms and carriages will be ready during the coming fiscal year. One hundred and ten feet of connecting roadway was built; the top surfaces of six magazines were plastered and painted with a bituminous paint, making them waterproof. There remain to be done: Filling gaps in parapets, estimated to require 1,107 yards of concrete; finishing terrepleins and platforms; covering the top surfaces of masonry with a layer of asphalt, and furnishing elevating machinery for three emplacements and overhead travelers for six.

Ground was broken on the mortar battery in April, 1893. During the last fiscal year the excavation of the battery was finished; the rooms and passages were built, plastered, and painted with bitumen; floors of artificial stone laid in all the rooms and passages, except one passage. The masonry structure was covered with earth, sodded or planted in grass, completing the fill, except about 400 cubic yards.

The mortar pits were excavated and the retaining walls of the slope were built. Two platforms were laid in granite, and some work done on two other platforms. The electric-light system was put in working order and conduits for firing wires were placed. Gates, doors, windows, and ventilators were put in place. It is expected that the battery proper, with its sixteen platforms, will be completed the present year.

Details relating to these batteries are given in Appendix No. 4.

Under an allotment of $72,000, made November 9, 1892, from appropriation of July 23, 1892, Lieut. Col. Benyaurd, in February, 1893, commenced the construction of emplacements for two 12-inch guns on nondisappearing carriages. During the past year the concrete work on these two emplacements was completed as far as contemplated. A layer of asphaltum, with an average thickness of about 4 inches, was placed upon the top of the emplacements; the magazine doors were made and hung; the outside work was plastered and a coat of hard finish placed upon the interior walls; the floors were laid, and everything finished except the machinery and the plastering of the hoisting room and elevator shaft. This latter work will be done when arrangements are made for putting in the platforms, preparatory to mounting the guns; of three platforms one is expected to be built this year.

Lieut. Col. Benyaurd commenced the construction of a mining casemate in January, 1893, and, with the exception of a few minor details, completed it the fiscal year preceding the last. During the last year the doors were made and hung, the steps leading to the casemate were put in place, a drain was put in on top of the work, and the slopes weeded and cared for.

An iron folding gate was placed in the passageway inside the outer door. This gate can be locked and the door left open so as to permit a free circulation of air in the casemate. The casemate is completed, except the inside woodwork and the concrete channel for the cables outside the cable gallery.

The act approved August 1, 1894, appropriated $400,000 for the construction of gun and mortar batteries, and $100,000 for the construction of platforms. The former amount will be almost wholly applied to commencing the construction of a battery for three 12-inch guns on lifts for the defense of Philadelphia, and of two emplacements for 10-inch disappearing guns for the defense of Pensacola.

The appropriation of $100,000, with that of $50,000 made February 18, 1893, will enable all the 64 platforms to be built in the mortar batteries already begun, and 3 platforms to be built for 12-inch nondisappearing guns. Emplacements for two 12-inch nondisappearing guns, for seventeen 10-inch, and five 8-inch disappearing guns will all await platforms by the end of the fiscal year; and additional emplacements for three 12-inch guns on lifts and two 10-inch guns on disappearing carriages will be under way. Not only will they await platforms, but the emplacements can not be completed until the platforms are built. The platforms are anchored by bolts to masses of concrete, and it is important that the lower roller paths of the platforms should be on hand when these masses are put in place, since the bolts are embedded in the concrete work and must be accurately placed to receive the roller paths. Thus, while appropriations are made for the construction of guns and of their emplacements, the end of these appropriations is not attained so long as no money is available for the construction of carriages. The Ordnance Department has a disappearing carriage which has been proved to be perfectly adapted to the 8-inch and 10-inch guns. Were that Department authorized and provided with funds to turn out carriages of the type referred to, there would then be a prospect of five 12-inch guns and twenty-four guns of 10-inch and 8-inch caliber being added to the defenses of our seacoast and capital.

The act approved August 1, 1894, appropriated $400,000 for the construction of gun and mortar batteries and $100,000 for that of gun and mortar platforms. From these appropriations allotments have been made as follows:

For preparing plans and estimates of certain batteries in Portland Harbor, Maine	$1,200
Completing mortar battery in Boston Harbor, Massachusetts	6,400
Commencing a battery for three 12-inch guns on lifts for the defense of Philadelphia, Pa	260,000
Construction of three emplacements for 10-inch guns on disappearing carriages for the defense of Pensacola Harbor, Florida	105,000
Unallotted	27,400
	400,000

For completing the mounting of 16 mortars in battery for the defense of Boston Harbor, Massachusetts	24,000
Same for 32 mortars for the defense of New York Harbor, New York	21,000
Same for 16 mortars and for one 12-inch gun on nondisappearing carriage for the defense of San Francisco Harbor, California	29,641
Unallotted	25,359
	100,000

PRESERVATION AND REPAIR OF FORTIFICATIONS.

An act approved February 18, 1893, appropriated the sum of $45,000 to be applied to the preservation, etc., of works for which there was no special appropriation. Such works number about 75. In other words, the amount appropriated averages about $600 per work, or about enough to pay for one custodian at each place, provided all was devoted to that purpose, and was, in fact, less than one-half of what the officers in charge of different works estimated as necessary.

During the year 11 new platforms were constructed and 2 platforms repaired to enable artillery target practice to be had or continued; casemates, buildings, revetments, sewers, fences, and sea walls were repaired. As authorized by law, part of the expense of the clerical force of this office was met from this appropriation, and fort-keepers, when needed, were paid from it.

Last fiscal year was marked by numerous and severe storms, no less than seven, which occasioned considerable damage. At two places it was estimated that the cost of repair would amount to more than two-thirds of the sum appropriated. But funds were not even available for completing the modification and the construction of platforms for artillery practice, so the damage due to storms could not be repaired.

For the present fiscal year the sum of $45,000 was again appropriated, an amount far too small for meeting urgent demands.

SITES FOR FORTIFICATIONS.

Fort McClary Reservation, Maine.—By act approved January 23, 1893, Congress authorized the Secretary of War to convey to school district numbered twelve of Kittery, Me., a certain described portion of this reservation in exchange for other land, and appropriated $900 for the necessary expenses, and for the purpose of fitting the new site for the accommodation of the schoolhouse, and of moving the said schoolhouse to, and putting it up on, the said new site. The transfer of the sites was accomplished by deed, dated June 22, 1893, from the inhabitants of the school district numbered twelve of Kittery, Me., to the United States, and by deed, dated December 4, 1893, from the Secretary of War to the inhabitants aforesaid.

Contract has been made for preparing the new site and moving the schoolhouse and establishing it thereon for $575. At the close of the fiscal year the foundation on the new site was ready for the building.

Cushings Island, Portland Harbor, Maine.—The project for the defense of Portland Harbor contemplates the establishment of batteries on this island. The owners demanded more for the site than was thought to be a reasonable price, and, as authorized by the act approved August 18, 1890, condemnation proceedings were brought, looking to the acquisition of about 33.4 acres of land. The matter was taken up by the United States district court in December, 1893, and an award of $112,240 was made. This was accepted by the Government and the payments were made early in June, 1894, excepting one item of $9,000 due the company owning a hotel adjoining the property taken, this amount being in compensation for certain easements held over the land taken. The hotel company at first declined to settle on the basis of the award, claiming that by an appeal, proposed to be taken, a larger sum could be recovered from the United States, but has recently decided to accept the amount awarded. The cost of this site is $112,423.60.

Grovers Cliff, Boston Harbor, Massachusetts.—Condemnation proceedings were in progress at the commencement of the fiscal year for the acquisition of such parts of the sites as could not be obtained by agreement with the owners.

While the legal proceedings were in progress offers of compromise were received, and having been approved by the Secretary of War, the district attorney on March 9, 1894, by direction of the Attorney-General, discontinued the suits, as "a good title has been obtained to all the land for the Government."

The total area acquired in this vicinity is 50.3 acres, and at a cost of $270,642.79. But some buildings which it was necessary to have removed from the sites were sold at auction for $7,045, so the net cost of the property was $263,597.79.

Sullivans Island, Charleston Harbor, South Carolina.—The Secretary of War informed the governor of the State of South Carolina, April 3, 1894, that the project for the defense of this harbor contemplated the erection of three batteries on this island, and requested his cooperation in obtaining the passage of an act by the legislature of the State ceding the title to, and jurisdiction over, the sites of these batteries to the United States. Section 355, Revised Statutes, forbids the expenditure of public money upon sites for fortifications to be built by the United States until the title to, and the jurisdiction over, the same are in the United States.

SEA WALLS AND EMBANKMENTS.

Islands in New York Harbor, in charge of Lieut. Col. H. M. Robert, Corps of Engineers.

Bedloes Island.—The sea wall has been in need of repairs for a number of years and has suffered severely from storms during the year, particularly from that of April 11, 1894, and its condition is now such that the process of deterioration would go on at a rapidly increasing rate in succeeding storms. These repairs have therefore been ordered, and the cost will be defrayed in part from the appropriation for preservation and repair of fortifications. About 580 linear feet of new wall is required to complete the circuit of the island, at an estimated cost of $25,000.

Governors Island.—During the past year the riprapping of the foundations of the walls was completed, the pointing of the masonry walls was finished, the embankment back of the west sea wall was protected by covering it with broken stone for a width of 12 feet, and the old engineer landing near Castle Williams was extended and repaired.

The project for sea walls on this island is completed, and no further appropriation is needed for that work at present.

Davids Island.—The sea wall, 954 feet long, completed in 1890, and its embankment are in good condition. Slight repair to the embankment is needed where heavy storms have washed away part of the earth.

A survey of the shores of the island, made in June, 1891, to prepare estimates of cost of other needed sea walls upon this island, showed that protection is needed at the west shore, north of the coal dock. A suitable sea wall with embankment at this place is estimated to cost $30,000.

Estimates for other sea walls were also presented, but they are not deemed of as pressing importance as this one.

Defenses of Baltimore, Md.—Col. W. P. Craighill, Corps of Engineers, in charge. The sea wall of Fort McHenry is in need of extensive repairs, the cost of which is estimated at not less than $10,000.

WATER SUPPLY AT FORT MONROE, VIRGINIA.

Officer in charge, Maj. C. E. L. B. Davis, Corps of Engineers, with First Lieut. G. A. Zinn, Corps of Engineers, under his immediate orders until May 4, 1894; Division Engineer, Col. W. P. Craighill, Corps of Engineers.

The supply of water is dependent upon rain water stored in cisterns and water of inferior quality pumped through iron pipes from across Mill Creek. An adequate supply of wholesome water within the limits of the fortification should be obtained, if possible. The act of February 24, 1891, appropriated $6,000 for an artesian well, but this amount is not deemed sufficient to sink a well to a depth thought necessary. A brief account of previous attempts at sinking artesian wells and a résumé of information collected during the fiscal year ending June 30, 1893, are given in Appendix 6 A of the report of the Chief of Engineers for that year. The local officer recommends an appropriation of $14,000 additional to the $6,000 already appropriated.

ESTIMATES OF APPROPRIATIONS REQUIRED FOR 1895–'96.

For construction of gun and mortar batteries, to be applied to emplacements, and platforms, and mounting guns and mortars	$1,000,000
For purchase of land for fortifications	250,000
For protection, preservation, and repair of fortifications	85,000
For preparation of plans for fortifications	5,000
For sea walls and embankments	65,000
For artesian well at Fort Monroe, Va	14,000
For purchase of submarine mines and necessary appliances to operate them for closing the channels leading to our principal seaports	50,000
For needful casemates, cable galleries, etc., from which to operate submarine mines	50,000
	1,519,000

THE BOARD OF ENGINEERS.

The Board, as at present constituted, consists of the following officers of the Corps of Engineers: Col. Henry L. Abbot, Col. C. B. Comstock, Lieut. Col. Henry M. Robert, and Lieut. Col. G. L. Gillespie.

Col. G. H. Mendell, Corps of Engineers, is also a member of the Board when it is acting upon matters pertaining to defensive works on the Pacific coast; and Col. W. P. Craighill, Corps of Engineers, is a member of the Board when it is considering subjects relating to defensive works in the southeast division.

The Board has considered the various subjects referred to it during the past year by the Chief of Engineers, and the following is a brief summary of the reports rendered thereon:

1893, July 7. On gun platform for 8-inch nondisappearing carriage.

August 5. On diameter of holes for hold-down bolts for platforms for 8-inch nondisappearing carriage.

August 23. On sites at Fort Monroe for platforms for 8-inch barbette B. L. rifle.

August 23. On Senate bill No. 54, for bridge across the Hudson River between New York City and New Jersey.

August 23. On mining casemate and cable gallery at Fort Pickens, Fla.

August 24. On Senate bill No. 296, authorizing the construction of bridges over the Hudson River between New York and New Jersey.

September 12. Detailed plans for the defense of Baltimore, Md.

September 13. On modifications of plans for emplacement for seven 10-inch-gun battery at Fort Hamilton, N. Y.

October 14. On repairs rendered necessary at Fort Sumter, S. C., on account of damage by storms.

October 14. On retention in service of Mr. Jay Stone, chief clerk and stenographer to the Board.

October 16. On the use of iron beams in place of concrete arches in gun-lift battery construction.

October 14. On permanent platforms for 10-inch and 12-inch nondisappearing barbette carriages.

October 28. On the Payne auto-mobile torpedo.

November 2. On hold-down bolts for mortar carriages.

November 15. On Mr. E. Kind's device for constructing forts and war vessels.

November 15. On the use of a positive lock for hold-down bolts for mortar carriages.

December 18. Detailed plans for the defense of Mobile, Ala.

1894, January 29. Detailed plans for the submarine mine defense of Philadelphia, Pa.

February 15. On acquisition of land for the defense of Key West, Fla.

March 6. Detailed plans for the defense of the mouth of the Cape Fear River and Wilmington, N. C.

March 6. Detailed plans for the submarine mine defense of the mouth of the Cape Fear River and Wilmington, N. C.

March 13. On modification of plans for 2-gun battery at Portland Head, Maine.

March 22. On a uniform plan for firing mortars in seacoast batteries, accompanied by a memorandum by Col. Abbot on firing arrangements for the typical mortar battery.

April 3. Detailed plans for the defense of Key West, Fla.

April 5. Detailed plans for the defense of Philadelphia, Pa.

April 24. On modification of plans for 5-gun battery emplacement at Fort Wadsworth, N. Y.

April 25. On acquisition of land for the defense of Key West, Fla.

In the performance of the duties of the Board The following personal examinations were made:

Under the orders of the Chief of Engineers, dated September 14, 1893, the Board made an inspection of the defensive sites at New Castle, Del., Delaware City, Finns Point, and Fort Delaware.

Under the orders of the Chief of Engineers, dated December 13, 1893, the Board made an inspection of the defensive sites at Wilmington, N. C., and at the mouth of the Cape Fear River.

Under the orders of the Chief of Engineers, dated December 13, 1893, the Board made an inspection of the defensive sites at Key West, Fla.

Under the orders of the Chief of Engineers, dated March 8, 1894, the Board made an inspection of sites for the defense of San Diego, Cal., of the mouth of the Columbia River, and of Puget Sound.

In addition to their duties with The Board of Engineers, the individual members of the Board have been otherwise engaged, as follows:

1. Col. Henry L. Abbot, the president of the Board, has continued as Division Engineer of the Northeast Division; as president of the Board to establish harbor lines for the harbor of New York and its adjacent waters, and as member of the Board of Ordnance and Fortification. He has also served as president of a board for the examination of officers of the Corps of Engineers with a view to promotion; as president of a board to consider and report on proposed docks at Squaw Island, Niagara River, and under instructions from the Chief of Engineers, dated July 30, 1892, June 30, 1893, and March 1, 1894, has inspected the engineering works in the charge of Lieut. Cols. Robert, Hains, Gillespie, Smith, Mansfield, and King, Corps of Engineers, as well as those of the six district officers of the Northeast Division.

2. Col. C. B. Comstock has served as Division Engineer of the Southwest Division; as member of the Board of Visitors to the U. S. Engineer School; as president of the Mississippi River Commission; as member of the board to establish harbor lines for the harbor of New York and its adjacent waters; as member of the board to establish harbor lines for the port of Philadelphia; has been a member of a board to make investigation as to certain bridges; as member of a board to consider and report on proposed docks at Squaw Island, Niagara River; as member of a board for the examination of Engineer officers with a view to promotion; and has been a member of a general court-martial.

3. Lieut. Col. Henry M. Robert has been the disbursing officer of The Board of Engineers. He has conducted the various works of river and

harbor improvement and fortifications under his charge, and has served as a member of the Board of Visitors to the U. S. Engineer School; as a member of the board for establishment of harbor lines for the harbor of New York and its adjacent waters, and of Stamford Harbor, Connecticut, and as member of a board for examination of officers of the Corps of Engineers with a view to promotion. He is also charged with the supervision of the construction of a bridge across Nortons Creek, Hempstead, N. Y.

4. Lieut. Col. G. L. Gillespie, in addition to conducting the various works of river and harbor improvement and of harbor defense with which he was charged during the year, has continued to serve as a member of the Board of Visitors to the U. S. Engineer School, and as a member of the harbor line boards for the harbors of New York, and of Stamford, Bridgeport, and Norwalk, Conn. He has also been designated to represent the War Department at the Sixth Congress of Internal Navigation to be held at The Hague, Netherlands, July 22 to 28, 1894.

POST OF WILLETS POINT, N. Y.—U. S. ENGINEER SCHOOL—BATTALION OF ENGINEERS—ENGINEER DEPOT.

Officer in command, Lieut. Col. W. R. King, Corps of Engineers.

POST OF WILLETS POINT, N Y.

At the close of the fiscal year the garrison consisted of 23 commissioned officers and 380 enlisted men, including officers and noncommissioned officers of the general staff, student officers, and enlisted men of the Hospital Corps. This is a gain of 2 officers and 45 enlisted men in strength over last year's report.

U. S. ENGINEER SCHOOL.

During the year 3 engineer officers and 4 line officers completed the course, and 1 artillery and 4 infantry officers, who have completed the laboratory duty, are still engaged in the practice work of planting and operating torpedoes, which will be completed October 1, 1894. First Lieut. A. B. Shattuck, Twenty-fifth Infantry, was relieved from duty at U. S. Engineer School May 2, 1894, in compliance with Special Orders 100, Adjutant-General's Office, April 28, 1894.

All have manifested intelligence and interest in the work and are entitled to certificates of proficiency in one or more of the branches they have been studying and practicing.

BATTALION OF ENGINEERS.

The legal strength of the Battalion of Engineers is 5 companies of 150 men each, with a sergeant-major and a quartermaster-sergeant, and is officered by details from the commissioned officers of the corps.

The present strength is 17 officers and 466 enlisted men.

The authorized strength of Companies A, B, and C, which are stationed at Willets Point, is 133 men each, and of Company E, stationed at West Point, N. Y., 100 men.

The total losses from all causes during the year have been 152, and the total gain 200, making a net gain of 48 men.

The Battalion of Engineers has been employed during the year at engineer, ponton, and torpedo drills, infantry drills, rifle practice, and photography, and Company E, at West Point, has assisted in the instruction of cadets in military engineering and ponton drill.

Of the 5 companies constituting the legal strength of the battalion, 1 company at present exists only on paper. In time of threatened danger to our seacoast, engineer troops will be called upon to prepare the fixed submarine mining defenses of our harbors. With the full legal strength, their number must be insufficient for this work, when we consider the number of places to be simultaneously prepared. Mining casemates are building, several are completed; but the necessary force to plant the mines to be operated from these casemates does not exist. Some slight relief may be obtained by restoring each and every company to its full legal strength of 150 men. Supposing this done, 750 men is but a small nucleus around which to further develop engineering enlisted strength in time of danger. The fifth company thus restored to an active existence, one of the others should be stationed on the Pacific coast; and by its presence there valuable time would be saved, which otherwise would be devoted to the transportation of the company across the continent, when that coast is threatened.

Among the recommendations of Lieut. Col. W. R. King, Corps of Engineers, commanding this battalion, is one to increase the pay of noncommissioned officers. Especially should some increase be given to those who are detailed as first sergeants of companies; and $40 per month for the first two years' service, with increments as now for additional years of service, would not be excessive for this class of noncommissioned officers. Some idea of the intelligence and duties required of them may be had from the more detailed report of Lieut. Col. King, to be found in Appendix No. 5.

ENGINEER DEPOT.

The engineer depot is the repository of tools and materials for pontoon bridges, sieges, torpedo service, and instruments for surveys and astronomical work upon which the Corps of Engineers may be engaged.

Some additions have been made to the stock of pontoon materials, and those on hand have been overhauled and repaired when necessary.

Surveying, astronomical, and electrical instruments have been repaired by enlisted men detailed for the purpose, and such new instruments as were needed for issue to officers in the field have been purchased in the usual manner.

Torpedo materials have also been procured and sent to such points as have been designated for storage.

About 84 miles of single and multiple cable for torpedo defense has been bought and about 50 miles of it has been delivered.

A new concrete tank for storing cable, the third in number, has been built and the cable is now being stored in it.

Experiments with explosives, building materials, and with the Sims Edison torpedo have been continued during the year.

Minor repairs have been made to buildings, and the engineer models sent to the World's Columbian Exposition have been received back, unpacked and properly arranged and labeled in the model building.

Suitable additions have been made to the Engineer School Library of recent books on military and civil engineering and kindred scientific subjects.

STATEMENT OF FUNDS.

Congress has at various times appropriated as follows:

1. For engineer depot at Willets Point, N. Y., for fiscal year ending June 30, 1894	$11,000.00
Expended and pledged	10,612.37
2. For engineer depot at Willets Point, N. Y. (no limit), for fireproof storehouse	16,000.00
July 1, 1894, balance unexpended and available	2,931.21
3. For torpedoes for harbor defense, act September 22, 1888:	
July 1, 1893, balance unexpended	5,000.00
July 1, 1894, balance unexpended and available	5,000.00
4. For torpedoes for harbor defense, act March 2, 1889:	
July 1, 1893, balance unexpended	18,362.87
July 1, 1894, balance unexpended and available	9,169.03
5. For torpedoes for harbor defense, act August 18, 1890:	
July 1, 1893, balance unexpended	24,598.85
July 1, 1894, balance unexpended and available	23,072.60
6. For torpedoes for harbor defense, act February 24, 1891:	
July 1, 1893, balance unexpended	83.70
7. For torpedoes for harbor defense, acts March 2, 1889, and August 18, 1890 (reallotments for purchase of submarine cable):	
July 1, 1893, balance unexpended	74,961.12
8. Board of Ordnance and Fortification, act February 24, 1891 (for telegraph line between Forts Wadsworth and Hamilton, N. Y.):	
September 12, 1893, amount allotted	1,275.00
9. For engineer depot at Willets Point, N. Y., for the fiscal year ending June 30, 1895	10,000.00

There will be required for the fiscal year ending June 30, 1896, for the engineer depot at Willets Point, N. Y., the following, viz:

1. For incidental expenses of depot	$5,000.00
2. For purchase of materials for instruction of battalion	500.00
3. For purchase and repair of instruments	3,000.00
4. For purchase and binding of professional works for library	500.00
Total	9,000.00

(See Appendix No. 5.)

RIVER AND HARBOR IMPROVEMENTS.

The funds with which the works for the improvement of rivers and harbors were prosecuted during the last fiscal year were derived from the appropriations by the river and harbor act approved July 13, 1892, and appropriations in the sundry civil act approved March 3, 1893, for certain works on account of which contracts were to be made for completion as provided in the acts of September 19, 1890, and July 13, 1892, and such balances of former appropriations as were available.

A brief statement derived from the reports of the officers in charge of the several works hereinafter given sets forth the condition of each improvement, the extent of work performed during the last fiscal year, the amount expended, and estimate of amount required for its completion.

Section 2 of the river and harbor act approved March 2, 1867, requires that the Secretary of War shall annually submit to Congress a full estimate of the entire and permanent completion of each river and harbor work, and of the amount that can be profitably expended on each uncompleted work in the next fiscal year.

Reports are appended of the work accomplished in the removal of wrecks obstructing or endangering navigation, as provided for in section 4 of the river and harbor act approved June 14, 1880, and enlarged by provision in the river and harbor act of August 2, 1882.

Under the authority given to the Secretary of War in section 12 of the river and harbor act approved September 19, 1890, harbor lines have been established at the following localities: Greenport Harbor, Patchogue River, Harlem River, Westchester Creek, and Niagara River at Squaw Island, New York; Shrewsbury River near Sea Bright, N. J.; Delaware River at Philadelphia, Pa., and Camden, N. J.; Ohio River between Martins Ferry and Bellaire, Ohio; Missouri River at Kansas City, Kans., and Kansas City, Mo.; Superior Bay and Oconto Harbor, Wisconsin; Saint Joseph Harbor, Michigan; San Francisco Bay and Oakland Harbor, and Napa River at Napa, Cal.; and Everett Harbor, Washington.

Examinations were made, whenever required by the committees of Congress, of bills authorizing the construction of bridges upon which the views of the War Department were desired. Of the bills so examined, 32 originated in the Senate and 57 in the House of Representatives.

During the fiscal year examinations were made of such plans and locations as were submitted by parties interested of bridges proposed to be built over navigable waters subject to the approval of the Secretary of War, as authorized by acts of Congress. A brief statement is given of the action had in such cases.

Under sections 4 and 5 of the river and harbor act approved September 19, 1890, persons, corporations, or associations owning or controlling bridges over navigable waterways of the United States, which are unreasonable obstructions to the free navigation of such waters, after being given a reasonable opportunity to be heard, have been notified to so alter the bridges as to render navigation through or under them reasonably free, easy, and unobstructed. In each case the changes required to be made were specified in the notice, and reasonable time was prescribed in which to make them. A detailed statement of the cases is given further on in this report.

Reports made in compliance with the requirements of section 2 of the river and harbor act of July 5, 1884, and section 4 of that of August 5, 1886, of instances in which piers, breakwaters, or other works built by the United States in aid of commerce or navigation are used, occupied, or injured by a corporation or an individual, will be found in Appendix A A A.

The engineering works in the charge of this office are arranged in five divisions, and officers of the corps assigned as division engineers to overlook the works, as follows:

West of the Rocky Mountains: Pacific Division, Col. George H. Mendell. East of the Rocky Mountains: Northeast Division, Col. Henry L. Abbot; Southeast Division, Col. William P. Craighill; Southwest Division, Col. Cyrus B. Comstock; Northwest Division, Col. Orlando M. Poe.

South Pass of the Mississippi River.—During the fiscal year ending June 30, 1894, the legal channel was maintained at the head of the pass and through the jetties at its mouth; but during a period of fifteen days such channel was not maintained through the pass itself.

ATLANTIC COAST AND GULF OF MEXICO.

IMPROVEMENT OF RIVERS AND HARBORS IN MAINE AND NEW HAMPSHIRE.

This district was in the charge of Lieut. Col. Peter C. Hains, Corps of Engineers.

1. *St. Croix River, Maine.*—An examination and survey of the St. Croix River were made under the provisions of the river and harbor

act of August 11, 1888, and the reports on same were published in the Annual Report of the Chief of Engineers for 1890 (page 463). The available depth, at mean low water, over the shoals, was found to be from 6.5 to 9.5 feet, and in the upper part of the harbor at Calais but 1.5 feet. The channel was also narrow. In the report on the survey it was proposed to obtain a channel 12 feet deep at mean low tide, with a general width of 200 feet, but narrowed to 150 and 100 feet at the upper end. Such an improvement would enable steamboats to reach landings at the upper end of the harbor, and would allow large lumber vessels to fully load at the wharves, instead of having to drop downstream about 4 miles to complete their cargoes.

An appropriation of $35,000 was made by act approved September 19, 1890, coupled with the proviso "that the Government of the Dominion of Canada shall expend a like sum in the improvement of said river."

No work has yet been done, pending action by the Dominion Government, and none of the appropriation has been expended.

July 1, 1893, balance unexpended	$35,000.00
July 1, 1894, balance unexpended	*35,000.00
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	245,000.00

(See Appendix A 1.)

2. Lubec Channel, Maine.—This channel lies between the eastern extremity of the State of Maine and Campobello Island, Dominion of Canada.

Originally the channel was but 5 feet in depth at mean low tide, and but 2 feet at low water of spring tides.

The project, adopted in 1879 and subsequently modified, was for a channel 275 feet wide, 300 feet wide in the bends, and 12 feet deep at mean low tide.

The expenditures to June 30, 1893, amounted to $168,954.42.

The expenditures during the fiscal year just ended were 26 cents, making the total expenditures to the close of the year $168,954.68.

At the close of the fiscal year 1891 the project had been practically completed, and no work has been done since.

Under the provisions of the river and harbor act of September 19, 1890, an examination of Lubec Channel was made, and the report was published in the Annual Report of the Chief of Engineers for 1891 (page 616).

July 1, 1893, balance unexpended	$45.58
June 30, 1894, amount expended during fiscal year	.26
July 1, 1894, balance unexpended	45.32
Amount appropriated by act of August 17, 1894	5,000.00
Amount available for fiscal year ending June 30, 1895	†5,045.32

(See Appendix A 2.)

3. Moosabec Bar, Maine.—Before the improvement was commenced the entrance at the eastern end of Moosabec Reach was difficult, the channel being crooked, with ledges on either hand. The direct entrance was obstructed by a bar, on which the depth was only about 6 feet at mean low tide.

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*The act of August 17, 1894, authorizes the Secretary of War, in his discretion, to expend this amount in the improvement of Lubec Channel.

†To this must be added the amount transferred from St. Croix River.

The project, adopted in 1881, provided for a channel 14 feet deep at mean low tide and not less than 200 feet wide through the bar at the eastern entrance to the reach. In 1888 the project was extended to provide for widening the 14-foot channel to 300 feet, for removal of ledges obstructing the channel, and for the construction of a small breakwater to divert cross currents.

The expenditures to June 30, 1893, were $60,793.65. At that date the 300-foot channel had been completed to the full projected width and depth, the breakwater had been built, and a small quantity of ledge had been removed.

The expenditures during the past year amounted to $14,638.36.

The operations consisted in excavation of 1,047 cubic yards of ledge obstructing the western approach to the dredged channel, making a depth of 16 feet at mean low tide. The price was $13.35 per cubic yard, measured in place.

Another contract was made March 22, 1894, for continuing the removal of ledge in the western approach to the channel, at $13.25 per cubic yard, measured in place. It is expected to remove, under this contract, about 800 yards, the contract to be completed during the present season. The work was commenced in May, 1894, and was in progress at the close of the fiscal year.

The benefits derived from the improvement are not local, the thoroughfare being extensively used by coastwise vessels, both as a harbor of refuge and as a sheltered route.

July 1, 1893, balance unexpended		$24,206.35
June 30, 1894, amount expended during fiscal year		14,638.36
July 1, 1894, balance unexpended		9,567.99
July 1, 1894, outstanding liabilities	$300.00	
July 1, 1894, amount covered by uncompleted contracts	9,000.00	
		9,300.00
July 1, 1894, balance available		267.99
Amount appropriated by act of August 17, 1894		6,000.00
Amount available for fiscal year ending June 30, 1895		6,267.99
Amount (estimated) required for completion of existing project		59,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896		25,000.00

Submitted in compliance with requirements of sections 2 of river and harbor act of 1866 and 1867 and of sundry civil act of March 3, 1893.

(See Appendix A 3.)

4. *Narraguagus River, Maine.*—The obstruction to navigation consisted in a bar at the mouth of the river, over which there was a navigable depth of less than 6 feet at mean low tide, and less than 4 feet at extreme low tide.

The project for improvement is to dredge a channel not less than 200 feet wide, having 11 feet depth at mean low tide from the deep water of the bay to Long Point, and a depth of 9 feet from thence to the anchorage.

The expenditures to June 30, 1893, amounted to $27,543.72. At that date there had been dredged an 11-foot channel from the deep water in the bay in toward the new steamboat wharf, 90 feet wide, with a space in front of the wharf 300 feet wide. From the new steamboat wharf to the old one near Long Point the channel was 100 feet wide, with a turning basin in front of the old wharf 300 feet wide.

The expenditures during the fiscal year ending June 30, 1894, amounted to $15.68. No work was in progress during the year. Proposals for dredging were opened October 3, 1892, and again November 16, 1892, but each time all bids were rejected, the prices being high. The work will be again advertised.

July 1, 1893, balance unexpended	$7,456.28
June 30, 1894, amount expended during fiscal year	15.68
July 1, 1894, balance unexpended	7,440.60
Amount appropriated by act of August 17, 1894	5,000.00
Amount available for fiscal year ending June 30, 1895	12,440.60
Amount (estimated) required for completion of existing project	10,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix A 4.)

5. Breakwater from Mount Desert to Porcupine Island, Bar Harbor, Maine.—The anchorage in front of the town of Bar Harbor, as well as the wharves at which steamers land, is exposed to storms and seas from southerly directions, at times rendering the anchorage insecure, and the landing of passengers and freight at the wharves difficult.

The original project was to construct a riprap breakwater in a direct line from Porcupine Island to Dry Ledge, and thence to within a short distance of Mount Desert Island. The direction of that portion west of Dry Ledge was afterwards slightly changed, so that the westerly end of the breakwater would be somewhat farther to the southward. In January, 1893, the project was again amended, and now provides for a breakwater on the direct line first proposed, but somewhat shorter, terminating at a distance of about 600 feet from the low-water line on Mount Desert Island, reducing the estimated cost to somewhat more than one-half that of the project of 1890, but answering all needful requirements.

The expenditures up to the close of the fiscal year ending June 30, 1893, amounted to $53,535.92. At that date the part of the breakwater between Porcupine Island and Dry Ledge had been completed, and 9,921 tons of stone had been deposited in the work west of Dry Ledge.

The expenditures during the fiscal year just ended were $47,534.60.

At the close of the fiscal year 1893 work was in progress, under contract, on that part of the breakwater west of Dry Ledge. The contract was completed early in October, 1893, the entire quantity of stone delivered under the contract being 49,258 tons; the breakwater west of Dry Ledge was at that time completed to full section for a distance of 325 feet.

November 22, 1893, a contract for continuing the construction of the breakwater was made with William S. White of Rockland, Me., at 97 cents per ton, about 50,000 tons of stone to be deposited. The contractor commenced work late in April, 1894, and at the close of the fiscal year about one-half the amount of stone covered by the contract had been deposited in place.

July 1, 1893, balance unexpended		$96,464.08
June 30, 1894, amount expended during fiscal year		47,534.60
July 1, 1894, balance unexpended		48,929.48
July 1, 1894, outstanding liabilities	$24,450.00	
July 1, 1894, amount covered by uncompleted contracts	24,250.00	
		48,700.00
July 1, 1894, balance available		229.48
Amount appropriated by act of August 17, 1894		10,000.00
Amount available for fiscal year ending June 30, 1895		10,229.48

Amount (estimated) required for completion of existing project	$260,200.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	50,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

See Appendix A 5.)

6. *Bagaduce River, Maine.*—The Bagaduce is a small stream that empties into Penobscot Bay at Castine, Me. The upper part of the river divides into two branches, one called Northern Bay, and the other South Bay. Northern Bay, near South Penobscot, is a shoal sheet of water of about 700 acres area, the bottom of which for the greater part is bare at low tide. There is a narrow channel that runs from Bridges Point to Bowdens Wharf, which had a depth of less than 2 feet, and is obstructed by ledges near Winslows Island. The South Bay is obstructed by ledges at Johnsons Narrows. A project for the improvement of the Northern Bay was adopted in 1890, which has for its object the securing of a channel 100 feet wide and 6 feet deep at mean low tide, from Bridges Point to Bowdens Wharf, at an estimated cost of $45,000. It is also intended to remove a small quantity of rock obstructing the southern channel at Johnsons Narrows, at an estimated cost of $1,875.

The expenditures to the close of the fiscal year ending June 30, 1893, amounted to $219.72.

The expenditures during the year ending June 30, 1894, were $11,780.28, making the total expenditures $12,000.

In July, 1893, the work of dredging the channel was commenced, under contract with Edgar P. Lovering, and was continued until the latter part of the following November, when the funds were exhausted. Thirty thousand and fifty-two cubic yards of material was dredged and 506½ tons of large bowlders was removed. The channel was dredged its entire length for a width of 40 feet, but the full projected depth was not obtained throughout. There is now an available depth of about 2 feet more than before the improvement was commenced.

July 1, 1893, balance unexpended	11,780.28
June 30, 1894, amount expended during fiscal year	11,780.28
Amount appropriated by act of August 17, 1894	5,000.00
Amount (estimated) required for completion of existing project	29,875.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	25,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix A 6.)

7. *Penobscot River, Maine.*—The improvement of the Penobscot River was first undertaken in 1870, the project being for a channel not less than 150 feet wide, 12 feet deep at low tide, as far up as Bangor. At that time the channel was shoal and dangerous.

At Bangor the depth did not exceed about 6 feet at lowest stages, and navigation was obstructed by numerous rocks and ledges. The work was continued until 1880, and included also the removal of obstructions in the harbor at Bangor and at Bucksport, the expenditures aggregating $198,000. No further work was done until 1884, when a project was adopted for widening the channel at Bangor, and for certain improvements in the river below near Crosbys Narrows, at an estimated cost of $75,000. While this work was in progress a survey was made, under the river and harbor act of 1886, from Bangor to Bucksport Narrows, and a project was submitted for securing a 22-foot depth between Bucksport and Winterport, at an estimated cost of $365,000, making the combined cost of the two projects $440,000. The act of September 19, 1890, appropriated $25,000, and provided for dredging near Sterns Mill.

Another survey was ordered by the act of September 19, 1890, which was made, and the report published in the Annual Report of the Chief of Engineers for 1892 (pp. 533-540).

The general project under which the improvement of the Penobscot River is now being carried on may be stated as follows: To widen the channel at Bangor to 360 feet and a depth of 11 feet at extreme low tide; to widen, straighten, and deepen the channel near Crosbys Narrows and near Sterns Mill to a depth of 12 feet at extreme low tide, and to secure a channel depth of 22 feet at mean low tide between Bucksport and Winterport, the estimated cost of the entire work being $440,000.

This estimate includes the cost of the jetties at Frankfort Flats and High Head, in order to contract the waterway should contraction be necessary. It is thought, however, that as the deposit of sawdust and mill waste into the river has in a large measure been stopped, and as the channels at these places were obstructed chiefly by this material, the contraction works may not be necessary. The channel at Frankfort Flats was dredged in 1890 to 22 feet. Subsequently it filled up on the sides to some extent, the full depth in mid-channel being maintained. A recent survey shows that it has scoured out again, and there now exists a navigable channel not less than 500 feet wide, and 22 feet or more in depth at low tide. As this is all the project aims at, no further works of any kind are needed at Frankfort Flats.

The channel at High Head which had deepened in 1891, from natural causes, subsequently filled up to some extent, so that it became advisable to dredge a channel the full depth and width called for by the project. A recent survey shows that it has deepened again so that there is an available depth of 22 feet at low tide, though the channel is not as wide as it should be.

If the dredging now in progress at High Head gives as good results as that at Frankfort Flats has done, and there is every reason to believe that it will, no further work on this section of the river will be necessary. Under any circumstances it is believed that any filling that may take place in the future will be but temporary. A slight spring freshet will clear it, as it has done at Frankfort Flats.

The construction of jetties at Frankfort Flats and High Head should be avoided if practicable, on account of their great cost.

Under the circumstances no appropriation is asked for the Penobscot River.

The appropriations up to the close of the fiscal year ending June 30, 1893, aggregated $348,300, and the expenditures under the various projects to the same date amounted to $302,510.45. The results were the widening and deepening of the channel at Bangor from a depth of 6 feet at extreme low tide to 11 feet, for a width of 300 feet; the removal of rocks, ledges, and other obstructions; the removal of a shoal near Bucksport, and a general increase in depth and width of channels from the mouth up to Bangor.

The expenditures during the fiscal year ending June 30, 1894, amounted to $16,754.32.

The operations consisted in widening the channel at Bangor to the full width of 360 feet, which was completed late in November, 1893. The dredging of the channel to 22 feet at mean low tide at High Head was also commenced, and was in progress at the close of the fiscal year.

A contract for the latter work, and for redredging where the channel has shoaled at Bangor, was made May 9, 1894, all the work to be done during the present season.

July 1, 1893, balance unexpended		$45,789.55
June 30, 1894, amount expended during fiscal year		16,754.32
July 1, 1894, balance unexpended		29,035.23
July 1, 1894, outstanding liabilities	$500.00	
July 1, 1894, amount covered by uncompleted contracts	17,025.00	
		17,525.00
July 1, 1894, balance available		11,510.23
Amount (estimated) required for completion of existing project		290,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix A 7.)

8. *Belfast Harbor, Maine.*—Originally the harbor was not deep enough to accommodate the commerce. At one place the depth was only about 4 feet at mean low tide.

In 1876 a project for dredging was adopted, and the work was completed in 1879, at a cost of $22,000. No more work was done until 1890, when a new project was adopted by which it was proposed to dredge a channel 250 to 300 feet wide, and 15 feet deep at mean low tide, from the deep water at the entrance to the upper harbor; to dredge an area on the north side of the harbor to a depth of 8 feet, and to dredge an area on the south side of the channel to a depth of 13 feet.

The total expenditures up to June 30, 1893, were $35,026.05. At that date the 8-foot dredging had been completed, and the dredging at the channel of entrance was in progress.

The expenditures during the last fiscal year were $9,973.95.

Operations during the year consisted in dredging the channel of entrance under contract. Forty thousand and forty cubic yards of material—all that the funds would allow—was dredged, making the full depth of 15 feet at mean low tide for a width of from 125 to 225 feet.

July 1, 1893, balance unexpended	$9,973.95
June 30, 1894, amount expended during fiscal year	9,973.95
Amount appropriated by act of August 17, 1894	8,000.00
Amount (estimated) required for completion of existing project	24,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	24,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

(See Appendix A 8.)

9. *Camden Harbor, Maine.*—Before the improvement was commenced vessels drawing more than 6 feet could not reach the wharves at low tide.

The improvement projected is to dredge an area at the eastern part of the entrance to a depth of 12 feet at mean low tide; to dredge a channel on each side of the harbor, and the approach to the same, to a depth of 10 feet at mean low tide; to dredge small channels at the upper end of the harbor to a depth of 5 feet at mean low tide; and, after the completion of the above items, to dredge the middle ground of the harbor to the same depths as the adjacent channels.

The expenditures under the present project, to the close of the fiscal year ending June 30, 1893, were $11,041.93. As a result the western channel had been dredged to a depth of 10 feet at mean low tide throughout its entire length, including the approach, the latter to a width of 125 feet, and the channel itself to a width of 100 feet.

The expenditures during the last fiscal year were $11,934.28.

Operations during the year consisted in completing the dredging of the channel of entrance, and the area at the eastern part of the entrance, and about 400 feet of the 10-foot channel on the eastern side of the harbor. After the dredging was completed, 11 large bowlders which obstructed the entrance were removed by hired labor, at a cost of about $550.

July 1, 1893, balance unexpended	$11,958.07
June 30, 1894, amount expended during fiscal year	11,934.28
July 1, 1894, balance unexpended	23.79
July 1, 1894, outstanding liabilities	10.00
July 1, 1894, balance available	13.79
Amount appropriated by act of August 17, 1894	12,000.00
Amount available for fiscal year ending June 30, 1895	12,013.79
Amount (estimated) required for completion of existing project	25,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	25,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix A 9.)

10. Rockland Harbor, Maine.—The location of Rockland Harbor is such that, besides accommodating its own commerce, it affords a convenient refuge for large numbers of coasting vessels. When the project for a breakwater was adopted the harbor was open to easterly storms, the anchorage was unsafe, and the seas often broke over the wharves.

The project, as originally adopted in 1881, provided for two breakwaters, one starting from Southwest Ledge in the harbor and running in a northerly direction toward Jameson Point, a distance of 2,640 feet, the other starting from Jameson Point and extending southward about 1,900 feet. The estimated cost was $550,000. The top of each breakwater was to be only 5 feet above the level of mean low tide.

In 1887 the project was amended, so as to bring the top of the breakwater from Jameson Point to the level of high tide, leaving the other as originally designed. The estimated cost was thus increased to $650,000.

In 1890 the project was again modified. Instead of building the second breakwater from Southwest Ledge in a northerly direction, on which no work had been done, it was decided to prolong the one from Jameson Point in a southerly direction. By doing so a much larger area of the harbor would secure protection. The estimated cost of the new project was $632,500, this being inclusive of the part already constructed.

Up to the close of the fiscal year ending June 30, 1893, there had been expended on the breakwater the sum of $199,136.45, and about 220,054 tons of stone had been placed in position.

The above expenditures had resulted in protecting a part of the harbor, giving a secure harbor of refuge for many vessels that trade near this port.

During the fiscal year ending June 30, 1894, the expenditures were $19,859.05.

At the close of the fiscal year 1893 the work of extending the breakwater was in progress under a contract with William S. White. Operations were continued until the close of August, 1893, when the contract was completed. Thirty-seven thousand five hundred and nineteen tons of stone were delivered under this contract in all, building about 236 linear feet of breakwater. A small beacon was constructed to mark the end of the work. The total quantity of stone deposited in the breakwater up to the present time is 234,110 tons, and the work is practically completed to a point 2,451 feet from the shore.

July 1, 1893, balance unexpended	$20,863.55
June 30, 1894, amount expended during fiscal year	19,859.05
July 1, 1894, balance unexpended	1,004.50
Amount appropriated by act of August 17, 1894	30,000.00
Amount available for fiscal year ending June 30, 1895	31,004.50
Amount (estimated) required for completion of existing project	382,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	100,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, and of sundry civil act of March 3, 1893.	

(See Appendix A 10.)

11. Kennebec River, Maine.—Before the improvements were commenced the main channel of the river between the foot of Swan Island and Gardiner was obstructed by shoals near Beef Rock, with only 10 feet of water at mean low tide, by dangerous sunken ledges in Lovejoy Narrows, by a shoal below South Gardiner, with only 8 feet on it at mean low tide, and by a ledge at Nehumkeg Island. The steamboat channel to the west of Swan Island (at Hatchs Rock) was obstructed by a shoal over which there was only 7½ feet of water, and the channel between Gardiner and Augusta, a distance of 6½ miles, was obstructed by shoals which gave only a navigable depth of 3½ feet of water in low summer tides.

Appropriations were made at various times between 1827 and 1852 for improving the river, but the first regular project was adopted in 1866, and was for removing rocks and straightening and deepening the upper part of the river. The estimated cost was $50,000.

In 1868 the project was amended so as to give a wider channel, and the estimate was increased to $80,000. In 1871 the project was extended, the additional cost being estimated at $13,000, making the estimate for the entire project $93,000. It was again extended in 1872 to include the removal of ledges in Lovejoy Narrows, at an additional estimated cost of $30,603.61. This project was modified in 1873, and as modified was completed in 1877.

In 1881 a project was adopted for the improvement of the channel west of Swan Island and near the north end of it. The estimated cost of this project, which was completed in 1883, was $20,500.

The river and harbor act of 1886 provided for a new survey of the river from Bath to Augusta. This survey was made in 1887, and a project submitted for the further improvement of the river, giving 12 feet clear depth at low tide up to the Upper Sands Bar, near South Gardiner, 10 feet from thence to Hinckley Shoal, and 8 feet from thence to Augusta, together with an improvement of the steamboat channel west of Swan Island to 9 feet at mean low tide. The estimated cost of this project was $410,500, which estimate was subsequently increased to $428,500.

In August, 1892, the project was revised, and a general project for the improvement adopted, as follows: For a channel depth of 13 feet up as far as Sands Island; 12 feet from thence to Hinckley Shoal, and 10 feet from thence to Augusta; a steamboat channel 9 feet deep west of Swan Island, and the removal of old bridge piers at Hallowell, all the above depths being referred to mean low tide. The estimated cost of the revised project is $388,500.

The total expenditures for the river up to June 30, 1893, were $310,208.39.

The following work had been accomplished: The channel near Beef Rock had been improved to give a clear depth of over 12 feet, and a training wall nearly completed. The dangerous rocks in Lovejoy Narrows had been removed to a depth of 12 feet, and the channel straightened. The shoal near South Gardiner had been deepened from 8 to 10 feet, the ledge at Nehumkeg had been removed to 12 feet, the steamboat channel west of Swan Island had been deepened to 9 feet, and near the head of the island to 10 feet, the channel between Gardiner and Augusta had been deepened to 6½ to 7 feet, though some shoaling had since taken place, and the old piers of the bridge at Hallowell had been removed. A jetty, about 1,500 feet long, had been built at Upper Sands Bar.

The expenditures for the year ending June 30, 1894, have been $48,760.78.

Dredging, under contract, was in progress until the last of October, 1893. Ninety-two thousand three hundred and seventy-eight cubic yards of material, in all, was dredged under this contract, making a depth of 12 feet at mean low tide at Upper Sands Bar, Gardiner, Browns Island, and Hinckley Lower Shoal, and 10 feet at mean low tide at Hinckley Upper Shoal.

Excavation of ledge to 15 feet at mean low tide at Lovejoy Narrows was in progress during the season of 1893 until the 27th of November, when work was suspended for the winter. At the date of suspension about 611 cubic yards of rock had been taken out, or nearly one-third the total quantity contemplated by the contract.

The excavation was resumed early in May, 1894, and was in progress at the close of the fiscal year.

The deposit of stone in the Beef Rock Jetty, which was in progress at the close of the fiscal year 1893, was finished early in August.

The stone deposited in this way during the summer of 1893 amounted to 6,044 tons, practically completing the jetty.

July 1, 1893, balance unexpended		$85,141.61
June 30, 1894, amount expended during fiscal year		48,760.78
July 1, 1894, balance unexpended		36,380.83
July 1, 1894, outstanding liabilities	$1,261.92	
July 1, 1894, amount covered by uncompleted contracts	15,899.25	
		17,161.17
July 1, 1894, balance available		19,219.66
Amount appropriated by act of August 17, 1894		50,000.00
Amount available for fiscal year ending June 30, 1895		69,219.66
Amount (estimated) required for completion of existing project		113,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1896		100,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

(See Appendix A 11.)

12. *Harraseeket River, Maine.*—The act approved March 3, 1881, provided that a survey be made of this river. The survey was made in

July of that year, and a report submitted in December by the engineer of the district.

The river empties into Casco Bay at Stockbridges Point, about 12 miles northeast of Portland. From Stockbridges Point up to Westons Point the depth of water is no less than 10 feet at mean low tide, with no obstruction to navigation.

From Westons Point up to Freeport Landing, a distance of 4,500 feet, the depth diminishes so that for the greater part of the distance the bottom of the river is 3½ feet out of water at mean low tide. The rise and fall of tides here is 9 feet. The project recommended in 1881 was the dredging of a channel not less than 60 feet wide and 3 feet deep at mean low tide up to Freeport, and a turning basin 180 feet wide at the head of the channel. The estimated cost of the improvement recommended was $13,000.

No appropriation was made for the work, however, and a new survey was ordered in the river and harbor act of 1888. A project for the improvement was submitted January 4, 1889. This project was on a somewhat larger scale than the one previously suggested, and contemplated a depth of channel of 5 feet at mean low tide, which would give about 14 feet at high tide. The estimated cost of the project was $36,000.

No work had been done up to the close of the fiscal year ending June 30, 1893. The expenditures had been $47.80. Proposals for doing the work were opened October 3, 1892, and again November 16, 1892, but in each case the prices were considered high and all the bids were rejected.

The expenditures during the year ending June 30, 1894, were $669.20, making the total expenditures $717.

Bids for doing all the dredging covered by the existing project were again invited, and were opened September 30, 1893. A contract was made with Moore & Wright, of Portland, Me., at 17½ cents per cubic yard, the work to be done during the present season.

July 1, 1893, balance unexpended		$25,952.20
June 30, 1894, amount expended during fiscal year		669.20
July 1, 1894, balance unexpended		25,283.00
July 1, 1894, outstanding liabilities	$300.00	
July 1, 1894, amount covered by uncompleted contracts	24,000.00	
		24,300.00
July 1, 1894, balance available		983.00
Amount appropriated by act of August 17, 1894		5,000.00
Amount available for fiscal year ending June 30, 1895		5,983.00

(See Appendix A 12.)

13. Portland Harbor, Maine.—The entrance to the main part of the harbor of Portland or the anchorage has always been good, but prior to the improvements made by the Government the approach to the inner harbor was obstructed by a shoal known as the middle ground, over which the depth was only from 8 to 10 feet at mean low tide, while between it and Stamford Ledge the greatest available depth was only 16 feet. Besides, the best part of the wharf front of the city was exposed to the swell from the Atlantic, which sometimes made it dangerous for vessels to lie at the docks, and the depth along this front was in some places as little as 4 feet, making a part of it unavailable for commercial purposes.

The first work of improvement undertaken by the Government was the construction of the breakwater. This was begun as early as 1836. It was completed in 1874.

The project for the improvement of the harbor by deepening its waters was first undertaken by authority of act of Congress of 1868. The project was at that time to excavate a channel 300 feet wide through the southern slope of the middle ground to a depth of 20 feet at mean low tide, and the removal of the bar off the Grand Trunk wharves to the same depth.

In 1870 the project was amended so as to provide for a channel 400 feet wide, and in 1871 it was again amended so as to provide for a width of 500 feet.

In 1872 the improvement of Back Cove was added to the project, and in December of that year the project was further amended by providing for the dredging of the inner harbor up to the harbor commissioner's lines to a depth of 16 feet. By 1876 all the contemplated improvements had been executed except some dredging in the inner harbor.

In 1881 Congress made an appropriation for the further improvement of the harbor, and a project was adopted looking to the entire removal of the shoal known as the middle ground, at an estimated cost of $160,000. The project was completed in 1885.

In 1886 the Board of Trade of Portland asked for the further improvement of the harbor to a depth of 29 feet at low tide, and in 1886 this project was adopted, the estimated cost being $135,000. This is the project now in process of execution.

The total amount expended on the harbor up to June 30, 1893, inclusive of all works of improvement, was $551,336.43. These expenditures resulted in giving, by means of the breakwater, partial protection to vessels at the lower wharves, and, by means of dredging, an available depth to navigation of 29 feet at mean low tide—a depth sufficient to accommodate the largest class of ocean steamers.

The expenditures during the year ending June 30, 1894, have been $385.22.

No work was done during the year. In February, 1894, the project was amended to cover the widening of the upper end of the 29-foot channel, and the opening of a 25-foot channel to connect the deep water in the lower part of the harbor with that in the upper part.

A contract was made May 12, 1894, for doing the new work, amounting to about 150,000 cubic yards of dredging, to be commenced July 15, 1894.

July 1, 1893, balance unexpended		$25,140.62
June 30, 1894, amount expended during fiscal year		385.22
July 1, 1894, balance unexpended		24,755.40
July 1, 1894, outstanding liabilities	$200.00	
July 1, 1894, amount covered by uncompleted contracts	23,625.00	
		23,825.00
July 1, 1894, balance available		930.40

(See Appendix A 13.)

14. *Channel in Back Cove, Portland, Me.*—Before any work was done toward improving Back Cove there existed no channel, properly considered as such. Only the rudiments of an old channel existed, and, for the most part, even this was nearly dry at low tide.

The first project adopted had for its object the dredging of a channel, 100 feet wide and 8 feet deep at mean low tide, from Turkeys Bridge to the "stone-shed wharves." The estimated cost was $10,000. The project was completed in 1874.

A survey was made in 1886, and a new project adopted, having in view the widening of the channel to 300 feet and deepening it to 12 feet at mean low tide, with a turning basin at the upper end. The estimated cost was $180,000. This project is now in process of execution.

The expenditures under the existing project to the close of the fiscal year ending June 30, 1893, amounted to $76,330.21. At that date the channel had been extended for a distance of about 1,400 feet to a width of 160 feet; about 1,400 feet to a width of 165 feet, and the remaining length to a width of 90 feet, with a turning basin 400 feet wide at the upper end, all to the depth of 12 feet at mean low tide.

The expenditures during the fiscal year ending June 30, 1894, were $204.92. Practically no work was done during the last fiscal year.

A contract was made January 11, 1894, for dredging to the extent of about 110,000 cubic yards, the work to be done during the present season.

July 1, 1893, balance unexpended		$19,919.79
June 30, 1894, amount expended during fiscal year		204.92
July 1, 1894, balance unexpended		19,714.87
July 1, 1894, outstanding liabilities	$200.00	
July 1, 1894, amount covered by uncompleted contracts	15,620.00	
		15.820.00
July 1, 1894, balance available		3,894.87
Amount appropriated by act of August 17, 1894		20,000.00
Amount available for fiscal year ending June 30, 1895		23,894.87
Amount (estimated) required for completion of existing project		63,750.00
Amount that can be profitably expended in fiscal year ending June 30, 1896		50,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.		

(See Appendix A 14.)

15. Saco River, Maine.—The first work done on the Saco River was in 1827, when an appropriation was made for the erection of piers, placing beacons or buoys, and removing obstructions. Prior to this the depth of water on the bar was only about 2 feet at mean low tide, while much of the river was deeper. The entrance was also dangerous in rough weather, and the numerous projecting rocks and ledges in the river proper, in connection with the swift currents, made its navigation dangerous.

In 1866 a plan was proposed for the improvement of the mouth of the river, and a project adopted in 1867. The project was for the construction of a breakwater at the mouth of the river, the removal of sunken rocks, and the rebuilding of some of the most important piers, against which vessels might drift without damage. The project was completed in 1873 at a cost of $169,275.

Nothing more was done on the Saco until 1883, when a resurvey of the breakwater was made and a new project submitted for raising and repairing it, and extending it out to Sharps Ledge.

The river and harbor act of 1884 directed a survey to be made of the river. This was done in 1885, and a project submitted for the improvement of the river proper from its mouth to the head of navigation. In 1886 and 1888 appropriations were made for repairing and raising the breakwater, and for improving the river. In 1890 the two projects were combined, so that the one now in process of execution is for improving the Saco River, including the breakwater, and the construction of a jetty opposite the same.

The total expenditures on both river and breakwater up to June 30, 1893, were $291,697.29, and resulted in removing the dangerous ledges, in constructing piers to prevent vessels from being swept on the rocks, in constructing a substantial breakwater on the north side of the entrance, and the construction of a jetty on the south side of the entrance to contract the channel way with a view to obtaining a greater depth over the bar.

The expenditures during the fiscal year ending June 30, 1894, were $15,364.53, which have been applied to extending the jetty on the south side of the entrance, and to the construction of two small jetties at Cow Island, which latter were completed in November, 1893.

The jetty on the south side of the entrance has been extended to a point about 4,500 feet from the shore, and the effect has been to obtain deeper water than formerly, though the projected depth has not yet been fully secured.

The jetties at and near Cow Island have in a measure caused a deepening of the channel, but it is proposed to dredge about 50,000 cubic yards of material from the channels at Factory Island, and at and near Cow Island.

July 1, 1893, balance unexpended	$30,077.71
June 30, 1894, amount expended during fiscal year	15,364.53
July 1, 1894, balance unexpended	14,713.18
July 1, 1894, outstanding liabilities	2,487.47
July 1, 1894, balance available	12,225.71
Amount appropriated by act of August 17, 1894	10,000.00
Amount available for fiscal year ending June 30, 1895	22,225.71
Amount (estimated) required for completion of existing project	62,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	50,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix A 15.)

16. York Harbor, Maine.—A survey of York Harbor was made in August, 1884, in compliance with the requirements of the river and harbor act of July 5, 1884, and a project suggested having for its object the widening of the channel in three bends where the width did not exceed 75 feet and where the tidal currents are very strong. At the points referred to the channel was to be widened by dredging to 10 feet at mean low tide, that being about the ruling depth in the river. The estimated cost of the improvement was $25,000. It was found that the prices on which the estimate was based were too low, so that in 1887 the estimate was increased to $30,000.

In 1888 the estimate was again revised, as some of the material to be removed, which was supposed to be gravel and bowlders, proved to be solid ledge. The estimate that year was $44,000.

The total expenditures up to June 30, 1893, were $35,023.94. These expenditures resulted in widening and straightening the channel at the bends, giving much better facilities to navigation and rendering it more safe. Before the improvements were begun the channel was very crooked and difficult to navigate on account of the swift currents.

The expenditures during the fiscal year ending June 30, 1894, were $8,976.06, exhausting the funds.

During June and July, 1893, under contract, 5,878 cubic yards of material was dredged at the entrance and 12,143 in the harbor basin, removing the shoal at the entrance and widening the channel width in the harbor basin to about 225 feet.

The appropriation of 1892, which was for completing the improvement, having been expended, the project is regarded as completed.

July 1, 1893, balance unexpended	$8,976.06
June 30, 1894, amount expended during fiscal year	8,976.06

(See Appendix A 16.)

17. Bellamy River, New Hampshire.—A survey was made of the Bellamy River in 1887, and a project of improvement suggested at an estimated cost of $28,000.

The project is to secure a channel 50 feet wide and 5 feet deep at mean low tide from the mouth of the river up to Sawyer's Mill, at Dover. The rise and fall of the tide being about 7 feet, a high-water navigation of 12 feet will be secured.

The above project was adopted in 1888 and its execution is now in progress.

The expenditures up to the close of the fiscal year ending June 30, 1893, have been $19,681.61. These expenditures have resulted in giving a channel from the mouth of the river up to about 1 mile above Robert's brickyard 50 feet wide and 5 feet deep at low tide. In other words, about 1 mile was added to the navigable part of the river.

There were no expenditures during the fiscal year ending June 30, 1894, and there were no operations. Proposals for dredging were opened November 16, 1892, but, the prices being high, all bids were rejected. The work will be readvertised.

July 1, 1893, balance unexpended	$7,818.39
July 1, 1894, balance unexpended	7,818.39
Amount appropriated by act of August 17, 1894	7,500.00
Amount available for fiscal year ending June 30, 1895	15,318.39

(See Appendix A 17.)

18. Cocheco River, New Hampshire.—Before the improvement was begun the river from Dover to the Lower Narrows was much obstructed by bowlders, ledges, and shoals, the depth being in some places as little as 6 inches at mean low tide. The tide here rises and falls about 7 feet.

The first regular project for improvement was adopted in 1871, and looked to the forming of a channel 40 feet wide and 4 feet deep from the Lower Narrows up to Collin's wharf. The estimated cost was $45,000 Subsequently more accurate and extended surveys have shown the practicability and importance of extending the improvement up to the head of navigation, and the project was extended and the estimate increased to $85,000. This project was completed by 1879. The improvements had opened up a large commerce, employing large vessels where formerly only flatboats had been used, in consequence of which the project was still further extended by providing for a "cut off" through Alleys Point, widening to 60 feet and deepening to 5 feet the existing channels through Trickeys and Clements Point shoals and blasting and removing other obstructions. The extended project was completed in 1888.

In 1889 a new survey was made, in compliance with the requirements of the river and harbor act of August, 1888, and as the large increase of trade seemed to justify still further improvement of the river a new project was submitted, looking to obtaining a depth of 7 feet, increased to 7½ in rock, and a width of 50 feet in rock and 60 to 75 where the material is less expensive to remove. This project was adopted in 1890, and is estimated to cost $175,000.

The expenditures up to June 30, 1893, have been $194,434. These have resulted in giving a channel through the rocky bed of the river 5 feet deep at low tide and 40 feet wide in the narrowest parts.

The upper end of the channel, in front of the wharves at Dover, has been deepened to 7 feet at mean low tide for a length of 1,200 feet, with widths varying from 100 to 140 feet. Portions of the channel above and below Clement's wharf, of a total length of 600 feet, have also been dredged to the same depth.

The expenditures during the fiscal year ending June 30, 1894, have been $584.68.

A contract was made March 20, 1894, for the excavation of about 2,000 cubic yards of ledge in the Upper Narrows. The contractor began work early in May, 1894, and by the close of the year had made considerable progress.

The improvements in the navigation of the Cocheco have been of great benefit to the people of Dover and the vicinity. In the item of coal alone it is reported that not less than 35,000 tons is supplied annually, at a saving of 50 cents per ton, which could not have been done had no improvements been made.

July 1, 1893, balance unexpended		$15,566.00
June 30, 1894, amount expended during fiscal year		584.68
July 1, 1894, balance unexpended		14,981.32
July 1, 1894, outstanding liabilities	$300.00	
July 1, 1894, amount covered by uncompleted contracts	12,880.00	
		13,180.00
July 1, 1894, balance available		1,801.32
Amount appropriated by act of August 17, 1894		15,000.00
Amount available for fiscal year ending June 30, 1895		16,801.32
Amount (estimated) required for completion of existing project		120,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896		50,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

(See Appendix A 18.)

19. *Harbor of refuge at Little Harbor, New Hampshire.*—A survey was made of Little Harbor in 1882, and a plan of improvement proposed which looked to the opening of a channel of entrance to a depth of 9 feet at low tide, and a width of 100 feet, together with a basin 300 feet by 700 feet, which was to be protected by a rubblestone breakwater. The estimated cost was $33,000. This project was approved in 1886, and its execution entered upon. In 1887 the project was enlarged, as the old one did not seem to meet the requirements of those interested. The enlarged project provided for the construction of two breakwaters, one on the north, the other on the south side of the entrance to the harbor, and the dredging of an anchorage about 49 acres in extent, in the protected area, to a depth of 12 feet at mean low tide. The estimated cost of the enlarged project was $235,000. The project was adopted by Congress in 1888.

Before the improvement was begun the harbor was exposed to the full force of the sea in northeast gales, and the depth of water at the entrance and within the harbor was not sufficient to accommodate even small craft at low tide.

The total expenditures up to June 30, 1893, have been $45,490.86. These expenditures have been applied to dredging part of the area for an anchorage, and to the partial construction of the breakwater on the south side of the harbor.

The expenditures during the fiscal year ending June 30, 1894, were $44,018.92.

The operations consisted in completing the breakwater on the south side of the entrance, and in widening the channel or anchorage about 200 feet to the depth of 12 feet at mean low tide.

In March, 1894, a contract was made for construction of the breakwater on the north side of the entrance to the harbor. Work was commenced the 15th of May, and was in progress at the close of the year. It is expected to complete it the present season.

July 1, 1893, balance unexpended		$54, 509. 14
June 30, 1894, amount expended during fiscal year		44, 018. 92
July 1, 1894, balance unexpended		10, 490. 22
July 1, 1894, outstanding liabilities	$300. 00	
July 1, 1894, amount covered by uncompleted contracts	10, 000. 00	
		10, 300. 00
July 1, 1894, balance available		190. 22
Amount appropriated by act of August 17, 1894		10, 000. 00
Amount available for fiscal year ending June 30, 1895		10, 190. 22
Amount (estimated) required for completion of existing project		125, 000. 00
Amount that can be profitably expended in fiscal year ending June 30, 1896		25, 000. 00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

(See Appendix A 19.)

IMPROVEMENT OF RIVERS AND HARBORS IN EASTERN MASSACHUSETTS.

This district was in the charge of Lieut. Col. S. M. Mansfield, Corps of Engineers.

1. *Newburyport Harbor, Massachusetts.*—The object of the improvement is to create a channel through the outer bar, 1,000 feet wide and with a least depth of 17 feet at mean low water, or 24½ feet at mean high water.

The project, adopted in 1880 and modified in 1883, is to build two converging rubblestone jetties, so located as to give a proper direction to the current, and thereby produce and maintain the desired result. The estimated cost of the project was $375,000.

The original depth of water on the bar was 7 feet at mean low water.

To June 30, 1893, $251,841.87 had been expended, and the north jetty was completed for a length of 2,510 feet and partially completed for an additional length of 165 feet. The south jetty was 1,300 feet long, of which 1,077 feet were completed.

The Plum Island Dike was 817 feet long, 5½ feet high above mean low water, except near the center, where a weir 150 feet long and 2 feet above mean low water was left temporarily.

The sand catch in rear of the south jetty was in two branches, one 480 feet long and one 572 feet long.

During the year operations were continued under the contract of September 16, 1892, and 13,775 tons of stone was deposited in the north jetty; it is now 2,705 feet long, fully completed. The dike, the south jetty, and the sand catch remain unchanged since June 30, 1893.

A survey of the bar was made in June, 1894; it showed that the channel had steadily improved.

July 1, 1893, balance unexpended	$25,658.13
June 30, 1894, amount expended during fiscal year	17,881.97
July 1, 1894, balance unexpended	7,776.16
July 1, 1894, outstanding liabilities	6,716.07
July 1, 1894, balance available	1,060.09
Amount appropriated by act of August 17, 1894	20,000.00
Amount available for fiscal year ending June 30, 1895	21,060.09
Amount (estimated) required for completion of existing project	77,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	77,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix B 1.)

2. *Merrimac River, Massachusetts.*—The object of the improvement is to straighten, deepen, and widen the natural channel of the river from its mouth to the Upper Falls, a distance of 21½ miles.

The channel originally was narrow, crooked, and much obstructed by ledges, bowlders, and shoals; and below Newburyport by ledges, cribs, piers, and wrecks.

At mean low water vessels drawing not to exceed 7 feet could cross the bar and proceed about 6 miles above Newburyport.

The mean rise or fall of the tide at the mouth of the river is 7½ feet; at Haverhill bridge, 4 feet.

The project, originally adopted in 1870, proposed to remove obstructions from the Upper and Lower Falls, to remove Gangway Rock, to remove the wreck of the *Globe*, and to remove the "Boilers."

The cost was estimated at $69,025.

This project was revised and extended in 1874 to include the removal of rocks at Deer Island and Rock bridges, and at Little Curriers Shoal, so that the channel should have the following depths at ordinary high-water stages of the river: From the mouth to Deer Island bridge (5 miles), 16½ feet; thence to Haverhill bridge (12½ miles), 12 feet; thence to the foot of Mitchells Falls (1½ miles), 10 feet; through Mitchels Falls to the head of the Upper Falls (2½ miles), not less than 4½ feet, with the mill water at Lawrence running. This revised project was estimated to cost $147,000.

The total appropriations to date have been $242,366.72.

The expenditures to June 30, 1893, were $233,275.20, and the river channel had been improved in accordance with the modified project.

During the fiscal year a contract for the removal of the "Boilers" was completed by the removal of 350 cubic yards of rock.

The improved channel is in good order.

July 1, 1893, balance unexpended	$9,091.52
June 30, 1894, amount expended during fiscal year	3,779.80
July 1, 1894, balance unexpended	5,311,72

(See Appendix B 2.)

3. *Powow River, Massachusetts.*—Powow River is a tributary of the Merrimac River, into which it enters from the north about 3½ miles above Newburyport.

From its mouth tide water extends 9,600 feet in a narrow, crooked channel, not navigable at low water.

The project proposed for its improvement is to dredge a channel 9,600 feet long, 60 feet wide, and 12 feet deep at mean high water at an estimated cost of $77,000.

The total appropriations to date have been $12,000, but this amount is inadequate to obtain any appreciable benefit to commerce and will be retained in the Treasury until additional funds are provided.

No expenditures were made during the year ending June 30, 1894, and the original condition of the river is unaltered.

July 1, 1893, balance unexpended	$12,000.00
July 1, 1894, balance unexpended	12,000.00
Amount appropriated by act of August 17, 1894	15,000.00
Amount available for fiscal year ending June 30, 1895	27,000.00
Amount (estimated) required for completion of existing project	50,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	30,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix B 3.)

4. *Ipswich River, Massachusetts.*—Ipswich River empties into Plum Island Sound, about 9 miles south of Newburyport, Mass. It is navigable from its mouth to the wharves at Ipswich, a distance of 3 miles. Before improvement, at low water, not to exceed 1½ feet draft could be carried in a narrow channel.

The mean rise or fall of the tide is 8.4 feet.

The object of the improvement is to widen and deepen the natural channel of the river.

The original project was submitted in 1875. It proposed a channel 60 feet wide and 4 feet deep at mean low water.

In 1887 the project was modified by limiting the present improvement to opening a channel 60 feet wide and 4 feet deep through "The Shoals" and "Labor in Vain," and extending it to the "Deep Hole," opposite the town wharves.

The amount appropriated for this improvement to date is $7,500.

The amount expended to June 30, 1893, was $2,556.29.

On June 30, 1893, the improved channel was 4 feet deep at mean low water, 60 feet wide at "Labor in Vain," and 40 feet wide at "The Shoals;" and a contract was in force with Mr. Edgar P. Lovering, of South Boston, Mass., to remove 6,000 cubic yards by dredging, and thus complete the limited project.

Operations under this contract were commenced during the latter part of June, 1894, and as but 1,506 cubic yards was dredged during the fiscal year, the condition of the improvement at the date of this report is essentially the same as on June 30, 1893. The prospective benefits to commerce are increased facilities and safety to navigation.

July 1, 1893, balance unexpended		$4,943.71
June 30, 1894, amount expended during fiscal year		81.30
July 1, 1894, balance unexpended		4,862.41
July 1, 1894, outstanding liabilities	$527.10	
July 1, 1894, amount covered by uncompleted contracts	1,572.90	
		2,100.00
July 1, 1894, balance available		2,762.41

(See Appendix B 4.)

5. *Essex River, Massachusetts.*—Essex River empties into Ipswich Bay about 3 miles southeast of the mouth of Ipswich River, Massachusetts. It is navigable at high water to the wharves in the town of Essex, a distance of 6 miles, but no navigable low-water channel exists for 12,000 feet below the town wharves.

The mean rise or fall of the tide is 8.8 feet.

The object of the improvement is to widen and deepen the natural channel of the river.

The project for improvement was submitted May 15, 1891, and proposed a channel 60 feet wide, 4 feet deep at mean low water to the wharves at Essex, estimated to cost $25,000.

The total amount appropriated to date is $5,000.

As the available funds are insufficient to afford any appreciable benefit to commerce by their expenditure, no work has been done under the project and the original condition of the river remains unchanged.

The prospective benefits to commerce are increased facilities and safety to navigation.

July 1, 1893, balance unexpended	$5,000.00
July 1, 1894, balance unexpended	5,000.00
Amount appropriated by act of August 17. 1894	5,000.00
Amount available for fiscal year ending June 30, 1895	10,000.00
Amount (estimated) required for completion of existing project	15,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	15,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix B 5.)

6. *Harbor of Refuge, Sandy Bay, Cape Ann, Massachusetts.*—This bay is situated at the northeastern extremity of Cape Ann, Massachusetts. It is open to the full effects of easterly and northeasterly gales.

The proposed improvement contemplates the construction of a national harbor of refuge of the first class. The anchorage covered by the breakwater will contain 1,377 acres.

The estimated cost of the improvement is $5,000,000. The original project of 1884 proposed to build only the substructure of the breakwater of rubblestone. The present project, approved March 17, 1892, proposes to build the entire breakwater of rubblestone.

The total appropriations to date have been $600,000. The expenditures to June 30, 1893, not including outstanding liabilities, were $476,485.08.

The condition of the improvement on June 30, 1893, was as follows: 591,797 tons of stone had been deposited in the breakwater. Of this amount 591,073 tons was small stone (less than 4 tons weight), deposited below low water, and 724 tons was large stone (averaging 6 tons weight), deposited above mean low water. Four thousand six hundred feet of the breakwater was to a grade 22 feet below mean low water; 200 feet was to the grade of mean low water, and 50 feet of the breakwater was completed.

Operations were in progress under a contract to deposit 14,000 tons of large stone and 120,000 tons of small stone in the breakwater.

During the fiscal year 70,755 tons of small stone and 9,224 tons of large stone were deposited under this contract. Five hundred feet of the breakwater was essentially completed; 700 feet was brought to the grade of mean low water.

The prospective benefits to commerce and navigation by the completion of this harbor of refuge are increased safety to life and property, and a consequent reduction in freights and insurance.

July 1, 1893, balance unexpended		$123,514.92
June 30, 1894, amount expended during fiscal year		81,810.38
July 1, 1894, balance unexpended		41,704.54
July 1, 1894, outstanding liabilities	$20,769.34	
July 1, 1894, amount covered by uncompleted contracts	10,425.50	
		31,194.84
July 1, 1894, balance available		10,509.70
Amount appropriated by act of August 17, 1894		150,000.00
Amount available for fiscal year ending June 30, 1895		160,509.70
Amount (estimated) required for completion of existing project		4,250,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896		500,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.		

(See Appendix B 6.)

7. *Gloucester Harbor, Massachusetts.*—Gloucester Harbor is an important center for the fishing fleet of New England, about 20 miles north of Boston. Its inner harbor was originally obstructed by sunken rocks and shoals, and the approaches to the wharves were shallow, varying from 1 to 12 feet. The outer harbor was open to all southerly gales.

The first project for its improvement was submitted January 20, 1871, and proposed to build a breakwater from Eastern Point to Round Rock Shoal, and to clear the harbor of sunken rocks.

The present approved project was submitted in 1887. It proposed to remove from the inner harbor obstructing rocks and shoals, giving in front of the wharves, as far as Pew's wharf, 15 feet depth at low water, and 10 feet in Harbor Cove, and to build a breakwater from Eastern Point to Round Rock Shoal, in substantially the same location as that proposed in the project of 1871.

The total appropriations to date have been $80,000.

The expenditures to June 30, 1893, were $36,721.50, and at that date the condition of the improvement was as follows: Clam Rock, Pinnacle Rock, rock off J. Friend's wharf, and rock off Pew's wharf had been reduced to the level of the surrounding bottom, and Babsons Ledge to 14 feet below mean low water.

Two channels of approach to the wharves in Harbor Cove had been dredged; each 140 feet wide and 10 feet deep at mean low water. In the inner harbor 15 feet depth had been obtained in front of the wharves as far as the steamboat wharf, except over four small ledges uncovered by the dredging near the Halibut Company's wharf. Nothing had been done on the breakwater. Operations were in progress under a contract dated September 16, 1892.

During the fiscal year operations under this contract were completed, thus completing all dredging proposed by the project.

On March 6, 1894, a contract was entered into for the removal of ledges uncovered by the dredging to the projected depths. Operations under this contract were commenced in April, 1894, and at the close of the fiscal year 386 cubic yards had been removed. Nothing had been done on the breakwater.

July 1, 1893, balance unexpended		$43,278.50
June 30, 1894, amount expended during fiscal year		22,921.63
July 1, 1894, balance unexpended		20,356.87
July 1, 1894, outstanding liabilities	$2,297.38	
July 1, 1894, amount covered by uncompleted contracts	1,607.18	
		3,904.56
July 1, 1894, balance available		16,452.31
Amount appropriated by act of August 17, 1894		40,000.00
Amount available for fiscal year ending June 30, 1895		56,452.31
Amount (estimated) required for completion of existing project		712,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896		250,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.		

(See Appendix B 7.)

8. *Manchester Harbor, Massachusetts.*—Manchester Harbor is situated about 5½ miles northeast from the entrance of Salem Harbor, Massachusetts.

The channel was 100 feet wide and 6½ feet deep at mean low water up to Proctors Point; it then shoaled rapidly to a depth of 1½ feet at the "Narrows;" 1,400 feet from Proctors Point and for a further distance of 2,500 feet to the town wharves no low-water channel existed.

The project for its improvement proposed to dredge a channel from Proctors Point to the town wharves, 60 feet wide and 4 feet deep at mean low water, at an estimated cost of $14,300. The total appropriations to date have been $14,300. The expenditures to June 30, 1893, were $7,155.93.

On June 30, 1893, the improved channel was 35 feet wide, 4 feet deep at mean low water from Proctors Point to the railroad bridge, a dis- of 2,900 feet.

During the fiscal year operations were commenced and completed under a contract dated September 17, 1892; 22,222 cubic yards was dredged under this contract.

At the date of this report the proposed project for improvement has been completed, and the improved channel is in good condition.

July 1, 1893, balance unexpended	$7,144.07
June 30, 1894, amount expended during fiscal year	6,483.36
July 1, 1894, balance unexpended	660.71

(See Appendix B 8.)

9. *Salem Harbor, Massachusetts.*—Salem Harbor is 12 miles northward of Boston, Mass. It contains a well-sheltered, entirely unobstructed anchorage of about 110 acres, more than 18 feet deep at mean low water.

The principal city wharves are located on South River, a small stream entering the harbor. This river was 3,000 feet long, from 150 to 300 feet wide, and not navigable at low tide.

The original project for the improvement of this harbor was submitted December 16, 1872. It proposed to dredge a channel of approach to the mouth of South River, 1,730 feet long, 300 feet wide, and 8 feet deep at mean low water. This project was essentially completed in 1873–1875.

The present project was submitted December 2, 1889. It proposed to clear out the channel as originally dredged, and to extend it to the head of navigation, gradually reducing its width from 150 feet at the mouth of the river to 100 feet near the inner end of Derby wharf, and above this to excavate a channel 50 feet wide; to the inner end of Derby wharf, the improved channel to be 8 feet deep at mean low water, and above this point 6 feet deep. The total length of the improved channel to be 5,100 feet approximately.

The total appropriations to date have been $53,000. The expenditures to June 30, 1893, were $37,801.20. At that date the entrance channel, dredged in 1873–1875, had been cleared out to essentially its original dimensions, and the improved channel was 50 feet wide, 8 feet deep to near the inner end of Derby wharf, and thence to the head of of navigation 6 feet deep at mean low water.

On June 30, 1893, a contract was in force, dated September 17, 1892, to complete the proposed improvement. Operations under this contract were commenced in April, 1894, and it was satisfactorily completed in June, 1894.

At the date of this report the project for improvement is completed.

July 1, 1893, balance unexpended	$15,198.80
June 30, 1894, amount expended during fiscal year	2,437.59
July 1, 1894, balance unexpended	12,761.21
July 1, 1894, outstanding liabilities	9,122.44
July 1, 1894, balance available	3,638.77

(See Appendix B 9.)

10. Lynn Harbor, Massachusetts.—Lynn Harbor is 9 miles northeast from Boston.

The original channels were narrow and crooked and had but 6 feet depth at mean low water.

The project for improvement was adopted in 1884. It proposed a channel 200 feet wide, 10 feet deep at mean low water, through the outer and inner bars. It is supposed that the inner channel will require occasional dredging, and a training wall was proposed, if required, to aid in keeping the outer channel open.

On September 24, 1884, it was proposed to extend the inner channel 400 feet within the harbor line and to excavate at its inner end an anchorage basin 500 by 300 feet in area, 10 feet deep at mean low water, at a cost of $25,000.

The estimated cost of the original project was $157,000.

The total appropriations to date have been $101,000.

The amount expended to June 30, 1893, was $85,752.41. At that date the outer channel and basin were completed as proposed and the inner channel was 150 feet wide. A contract dated January 5, 1893, was in force to dredge a channel 150 feet wide, 8 feet deep at mean low water, at the entrance of the western channel, and to widen the inner channel of the main harbor to 200 feet, so far as the balance available would permit.

Operations under this contract were commenced in June, 1893, and were continued during the fiscal year. The contract was completed in August, 1893; 39,808 cubic yards was removed under the contract and the western channel was completed as proposed and the inner channel widened to 200 feet for 500 feet from its outer end.

July 1, 1893, balance unexpended	$15,247.59
June 30, 1894, amount expended during fiscal year	14,362.84
July 1, 1894, balance unexpended	884.75
Amount appropriated by act of August 17, 1894	7,500.00
Amount available for fiscal year ending June 30, 1895	8,384.75

Amount (estimated) required for completion of existing project	$73,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	20,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix B 10.)

11. Winthrop Harbor, Massachusetts.—Winthrop Harbor is situated in the northeastern part of Boston harbor. It contains 350 acres, approximately, all of which is essentially dry at low tide. The mean range of tides is 9.4 feet.

The original project for its improvement proposed to dredge a straight channel 3,900 feet long, 50 feet wide, 6 feet deep at mean low water, from the "Back" channel of Boston harbor to Rice's wharf.

The total appropriations to date have been $9,000.

The expenditures to June 30, 1893, were $8,974.85.

At that date the project was completed as proposed, the improved channel being 3,900 feet long, 50 feet wide, and 6 feet deep at mean low water.

July 1, 1893, balance unexpended	$25.15
June 30, 1894, amount expended during fiscal year	8.36
July 1, 1894, balance unexpended	16.79

(See Appendix B 11.)

12. Mystic and Malden rivers, Massachusetts.—These two rivers empty into the inner harbor of Boston, Mass.

Malden River is tributary to the Mystic River, their junction being about 3 miles above the mouth of the latter.

Originally no low-water channel existed in either river.

A project for the improvement of Mystic River was submitted May 9, 1891. It proposed to widen and deepen the natural channel to the head of navigation in Medford, a distance of about 4½ miles, so that it should be 100 feet wide, 6 feet deep at mean low water to the first turn above Denning's Wharf; thence 4 feet deep at mean low water, the width gradually contracting to 50 feet at the upper end; estimated to cost $25,000.

The original project for the improvement of Malden River was submitted December 1, 1880, and was modified in 1882. The modified project proposed to make the natural channel 100 feet wide, 12 feet deep at mean high water to the first bridge, and thence 75 feet wide to the second bridge, the estimated cost being $37,000. The mean range of tides is 9.8 feet.

Ten thousand dollars was appropriated for the improvement of Malden River in 1882, and expended in 1883-'84 in accordance with the project, making a channel 50 feet wide, 12 feet deep at mean high water to the first bridge.

The act of July 13, 1892, appropriated $10,000 for the improvement of Mystic and Malden rivers. Five thousand dollars of this amount is retained in the Treasury for the improvement of Malden River (when additional funds are available), and the balance will be expended in improving Mystic River as proposed.

No operations have been in progress during the fiscal year, and at the date of this report the original condition of the Mystic River is unchanged, and the improved channel in Malden River is 50 feet wide, 12 feet deep at mean high water to the first bridge in Malden, a distance of 1¼ miles.

July 1, 1893, balance unexpended	$9,958.45
July 1, 1894, balance unexpended	9,958.45
Amount appropriated by act of August 17, 1894	10,000.00
Amount available for fiscal year ending June 30, 1895	19,958.45
Amount (estimated) required for completion of existing project	40,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	40,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix B 12.)

13. Boston Harbor, Massachusetts.—The object of this improvement is, first, to preserve the harbor by protecting the islands and headlands; and, second, to improve it by widening, straightening, and deepening the channels.

The projects adopted for this purpose since 1866 have been mainly in accordance with the recommendations of the United States commissioners whose labors terminated during that year.

The works of preservation consist of sea walls, aprons, jetties, etc., which protect the shores of the islands and headlands, prevent additional wash into the channels, control tidal scour, and preserve the full height of anchorage shelter for vessels in the roadsteads. Such have been built or repaired at Point Allerton, and the islands of Great Brewster, Lovells, Gallops, Long, Deer, Rainsford, Georges, and Castle.

The works of improvement have been by dredging and blasting, by which means many dangerous rocks and shoals have been removed and the main ship channel enlarged from 100 feet wide and 18 feet deep at mean low water, so that it is now at least 625 feet wide and 23 feet deep at mean low water.

The following tributary channels have also been improved:

a. Charles River.—The natural channel of this river has been widened, straightened, and deepened, so that from its mouth to Western avenue bridge, a distance of 4¾ miles, the channel has a width of 200 feet and a depth of 7 feet at mean low water; thence to Arsenal street bridge, 2½ miles, the channel has a least width of 80 feet and a least depth of 6 feet.

b. Fort Point Channel.—This important branch of the main ship channel had a least depth of 12 feet at its entrance, and the channel was narrow and crooked. It has been widened to 175 feet and deepened to 23 feet at mean low water from its mouth to Congress street bridge, a distance of 1,900 feet.

c. Hingham Harbor.—See separate report.

d. Nantasket Beach Channel.—This channel was originally about 50 feet wide, 8 feet deep at mean low water. It is now 150 feet wide, 12 feet deep at mean low water.

e. Channel between Nix's Mate and Long Island.—This channel had originally 4½ feet depth at mean low water. A cut has been made through the bar 300 feet wide, 15 feet deep at mean low water.

f. Broad Sound.—An obstruction called Barrel Rock was removed in 1869.

g. Jeffreys Point Channel.—This channel is an extension of the main ship channel from near Grand Junction wharf (East Boston) toward Jeffreys Point. It is now 400 feet wide from Grand Junction wharf to just east of Simpson's patent dry docks, and 18 feet deep at mean low water; thence gradually narrowing the proposed channel to 250 feet, and decreasing the depth of water to 15 feet at mean low water to a junction with the same depth off Jeffreys Point.

The total expenditures to June 30, 1893, were $2,264,863.80.

On June 30, 1893, the main ship channel was 23 feet deep at mean low water, 1,100 feet wide west of the Upper Middle, 850 feet wide at the Upper Middle, 1,000 feet wide at the Lower Middle, and at least 625 feet wide elsewhere.

During the fiscal year the project for the Jeffreys Point Channel was completed, and the Nantasket Beach Channel was completed except the removal of a ledge near the steamboat wharf; 302,231 cubic yards was dredged from the main ship channel, and at the date of this report the improved channel is 27 feet deep at mean low water, 300 feet wide at the shoal east of Nashs Rock, 1,000 feet wide at the shoal west of Nashs Rock, 500 feet wide at the Centurion Shoal. In the Narrows the channel has been dredged 700 feet wide, but ledges were uncovered which, until they are removed, prevent the use of the increased depth. These ledges contain 4,532 cubic yards above the proposed grade.

The remainder of the main ship channel is in the same condition as on June 30, 1893.

July 1, 1893, balance unexpended		$339,412.30
June 30, 1894, amount expended during fiscal year		157,280.63
July 1, 1894, balance unexpended		182,131.67
July 1, 1894, outstanding liabilities	$30,206.89	
July 1, 1894, amount covered by uncompleted contracts	83,219.07	
		113,425.96
July 1, 1894, balance available		68,705.71
Amount appropriated by act of August 17, 1894		200,000.00
Amount available for fiscal year ending June 30, 1895		268,705.71
Amount (estimated) required for completion of existing project		1,135,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896		700,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.		

(See Appendix B 13.)

14. Weymouth River, Massachusetts.—Weymouth (Fore) River empties into the southwestern part of Boston Harbor, Massachusetts. For 4 miles it was navigable at low water for vessels drawing 18 feet, and to the head of navigation, an additional 3 miles, at least 3 feet depth was to be found.

The original project for its improvement was submitted December 2, 1889. It proposed to improve the natural channel so that 6 feet at mean low water could be carried to the head of navigation in a channel 100 feet wide to near Weymouth Landing, thence to Braintree bridge 80 feet wide, and above the bridge 50 feet wide; the total length of improved channel to be 7,000 feet, and to cost $40,000.

The total appropriations to date have been $20,000.

The expenditures to June 30, 1893, were $10,038.64. At that date the improved channel was 6 feet deep at mean low water, 40 feet wide to Braintree bridge, and 25 feet wide thence to the head of navigation.

No operations were in progress during the fiscal year, and the condition of the improvement remains unchanged since June 30, 1893.

July 1, 1893, balance unexpended	$9,961.36
July 1, 1894, balance unexpended	9,961.36
Amount appropriated by act of August 17, 1894	5,000.00
Amount available for fiscal year ending June 30, 1895	14,961.36
Amount (estimated) required for completion of existing project	15,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	15,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix B 14.)

15. Hingham Harbor, Massachusetts.—The object of this improvement is to widen and deepen the natural channel, which was 30 feet wide and 4 feet deep, so that it will be 100 wide and 10 feet deep at mean low water.

The project was originally proposed in 1874 and was modified in 1885. The original project was estimated to cost $11,000. The project of 1885 was to cost an additional sum of $18,750.

The total appropriations to date have been $29,000, and the expenditures to June 30, 1893, were $28,985.76.

On June 30, 1893, the project had been completed as modified in 1885.

No work has been done during the fiscal year, and at the date of this report the improved channel is in good condition.

The prospective benefits to commerce are increased facilities and safety to navigation.

July 1, 1893, balance unexpended	$14.24
June 30, 1894, amount expended during the fiscal year	14.24

(See Appendix B 15.)

16. Scituate Harbor, Massachusetts.—This harbor is on the west shore of Massachusetts Bay, about 14 miles south of Boston Light.

The object of the improvement is to create a harbor of refuge for vessels bound to Boston from the eastward which are too far south of their true course to clear the dangerous ledges near Minots Ledge Light.

Originally the harbor had a low-water area of about 57 acres, more than 6 acres of which had a depth of at least 3 feet at mean low water. It was entirely open to the force of easterly gales, and its entrance was obstructed by sunken bowlders.

The project adopted in 1880 is to build two breakwaters, one from Cedar Point, on the north side of the entrance, and the other from the First Cliff, on the south side, and to dredge the area inclosed and in front of the entrance. The estimated cost of the improvement is $290,000.

The total amount appropriated to date is $73,680.

The total amount expended to June 30, 1893, was $69,959.84. At that date the north breakwater was essentially completed. The south breakwater was essentially completed for 250 feet of its length, and operations were in progress under a contract dated September 17, 1892, for the deposit of 3,643 tons of rubblestone in it. The anchorage basin was 350 by 450 feet in area, 7 feet deep at mean low water. The channel connecting the basin with the town wharves was 2,100 feet long, 100 feet wide, 3 feet deep at mean low water.

During the fiscal year the contract dated September 17, 1892, for the deposit of rubblestone in the south breakwater, was completed.

At the date of this report the south breakwater is completed for 300 feet of its length. The north breakwater, anchorage basin, and improved channels remain unchanged since June 30, 1893.

The prospective benefit to commerce is the creation of an additional harbor of refuge on this much frequented dangerous coast.

July 1, 1893, balance unexpended	$3,720.16
June 30, 1894, amount expended during fiscal year	3,675.95
July 1, 1894, balance unexpended	44.21
Amount appropriated by act of August 17, 1894	10,000.00
Amount available for fiscal year ending June 30, 1895	10,044.21
Amount (estimated) required for completion of existing project	207,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	40,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix B 16.)

17. Plymouth Harbor, Massachusetts.—Plymouth Harbor is 30 miles south of Boston. The object of its improvement is to perpetuate the harbor by the preservation of Long Beach, which forms it, and to deepen and widen the channels of approach to an enlarged anchorage basin in front of the town wharves.

The various devices employed for the preservation of Long Beach are described in the Annual Report of the Chief of Engineers for the year 1877.

The original project for improvement was adopted in 1875 and modified in 1877 and 1884. The modified project proposed an improved channel 2,286 feet long, 150 feet wide, and 9 feet deep at mean low water, leading to an anchorage basin 866 feet long, 150 feet wide, and 9 feet deep.

The total appropriations to date have been $179,766.90.

The total expenditures to June 30, 1893, were—

For beach protection	$122,553.77
For dredging	50,514.89
Total	173,068.66

At that date the project for improvement had been completed. Long Beach was in good order, but additional bulkheads were needed at its southern end.

During the fiscal year a small force of hired labor was employed in building these bulkheads and repairing existing ones and at the date of this report Long Beach is in good order.

July 1, 1893, balance unexpended	$6,698.24
June 30, 1894, amount expended during fiscal year	4,680.65
July 1, 1894, balance unexpended	2,017.59
Amount appropriated by act of August 17, 1894	1,500.00
Amount available for fiscal year ending June 30, 1895	3,517.59
Amount that can be profitably expended in fiscal year ending June 30, 1896	1,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix B 17.)

18. Kingston Harbor, Massachusetts.—Kingston Harbor is one of the 3 divisions which together form Plymouth inner harbor.

The wharf at which supplies are landed for the town of Kingston is about 2 miles south of the center of the town, and is known as the Plymouth Cordage Company's wharf. No low-water channel of navigable dimensions existed to this wharf.

The project for the improvement was submitted May 25, 1891. It proposed to dredge a channel 100 feet wide, 6 feet deep at mean low water from deep water to the Cordage Company's wharf, at an estimated cost of $10,000.

The total appropriations to date have been $10,000.

The expenditures to June 30, 1893, were $8,937.64, and at that date the project had been completed.

No operations were in progress during the fiscal year, and at the date of this report the improved channel is in good order.

July 1, 1893, balance unexpended	$8,625.46
June 30, 1894, amount expended during fiscal year	7,565.55
July 1, 1894, balance unexpended	1,059.91

(See Appendix B 18.)

19. Wellfleet Harbor, Massachusetts.—Wellfleet Harbor is 12 miles southeast of Provincetown, on Cape Cod Bay. Originally no low-water channel to the town wharves existed. The object of its improvement is to provide a navigable channel from the inner anchorage, the "Deep Hole," to the town wharves.

The original project was submitted in 1871, and the present approved project was submitted November 28, 1887. It proposed to dredge a channel from the "Deep Hole" to the town wharves 4,200 feet long, 100 feet wide, and 6 feet deep at mean low water.

The total appropriations to date have been $16,000. The expenditures to June 30, 1893, were $11,350.37, and at that date the channel proposed was 25 feet wide, 4 feet deep at mean low water. Two hundred and four cubic yards of sunken rock had been removed under the project of 1871.

No operations were in progress during the fiscal year, as the funds available are not sufficient to secure any appreciable benefit to commerce, and at the date of this report the condition of the improvement is the same as on June 30, 1893.

July 1, 1893, balance unexpended	$4,649.63
July 1, 1894, balance unexpended	4,649.63
Amount (estimated) required for completion of existing project	22,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	22,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix B 19.)

20. Provincetown Harbor, Massachusetts.—Provincetown Harbor is situated at the extremity of Cape Cod, about 40 miles southeast from Boston Light. It is one of the most valuable harbors of refuge on the Atlantic coast.

Since 1826 the project has been a general one, and provides for the preservation of the harbor by building dikes, bulkheads, and sand catches, and extensive planting of beach grass, to repair and prevent storm damages to the beaches. A special dike across House Point Island Flats, to be built contingently, was recommended in the annual report for 1886. From the nature of the work it can at no time be considered completed.

The total appropriations to date have been $152,918.44. The amount expended to June 30, 1893, was $147,677.49.

No operations were in progress during the fiscal year, and at the date of this report all the works of preservation were in good order with the exception of the sand catches at the west end of Abel Hill Dike, for the repair of which sufficient funds are available.

July 1, 1893, balance unexpended	$5,240.95
July 1, 1894, balance unexpended	5,240.95
Amount appropriated by act of August 17, 1894	1,500.00
Amount available for fiscal year ending June 30, 1895	6,740.95
Amount that can be profitably expended in fiscal year ending June 30, 1896	1,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix B 20.)

21. Chatham Harbor, Massachusetts.—Chatham Harbor is at the eastern end of Nantucket Sound, about 15 miles east of Hyannis, Mass.

Its outer anchorage (Chatham Roads) is a valuable harbor of refuge from northerly and easterly gales. The inner harbor (Stage Harbor) is small but well landlocked, and has 8 to 12 feet depth at mean low water. Its entrance was obstructed by three bars, on which the greatest depth at mean low water was 4 feet.

The project for the improvement of this harbor, submitted December 19, 1890, proposes to dredge a channel through the three obstructing bars 6 feet deep at mean low water, 100 feet wide at the inner bar, 150 feet wide at the middle bar, and 200 feet wide at the outer bar, at a cost of $10,000.

The total appropriations to date have been $5,000.

The expenditures to June 30, 1893, were $4,402.15.

At that date the improved channel through the middle and inner bars was 100 feet wide, 6 feet deep at mean low water. Nothing had been done on the outer bar.

No operations were in progress during the fiscal year, and at the date of this report the condition of the improvement is the same as on June 30, 1893.

July 1, 1893, balance unexpended	$597.85
July 1, 1894, balance unexpended	597.85
Amount (estimated) required for completion of existing project	5,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	5,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix B 21.)

22. Removing sunken vessels or craft obstructing or endangering navigation.—Under the provisions of section 4 of the river and harbor act of 1880, the following wrecks were removed during the fiscal year: Schooner *Wildfire* from Provincetown Harbor, Massachusetts; three unknown schooners off Chatham, Mass.; and the steamer *Perit* from Chatham Bar, Massachusetts. The total cost of removing these wrecks was $1,486.75.

(See Appendix B 22.)

IMPROVEMENT OF RIVERS AND HARBORS IN SOUTHEASTERN MASSACHUSETTS, IN RHODE ISLAND, AND IN EASTERN CONNECTICUT.

This district was in the charge of Capt. W. H. Bixby, Corps of Engineers, with Lieut. William W. Harts, Corps of Engineers, under his immediate orders. Division Engineer, Col. Henry L. Abbot, Corps of Engineers.

1. *Harbor of refuge at Hyannis, Mass.*—This harbor before improvement was an open roadstead, exposed to southerly storms. In the years 1827–1838 a breakwater of riprap granite 1,170 feet long was constructed, covering an anchorage of about 175 acres, the entrance to which has a depth of about 15½ feet. Between the years 1852 and 1882 extensive repairs were made, increasing the width of its base and the size of the stone forming its sides and top.

The approved project of 1884 provides for the dredging to 15.5 feet depth at low water of about 36 acres of shoal area north of the existing breakwater, so as to increase the deep-water harborage by that amount; all at a total cost estimated in 1884 at $45,743.20 (including $81.20 left over from a former project), of which $34,081.20 was appropriated prior to 1894.

At the adoption of the present project the 15.5 feet depth anchorage covered only about 47 acres, and the 36 additional acres to be dredged carried an average of about 12 feet depth of water at low water.

The sum of $28,543.13 had been expended on this work up to June 30, 1893, by which 13 acres out of 36 had been dredged.

During the past fiscal year work of dredging under old contracts was commenced and completed, adding about 7 acres to the dredged area.

Further dredging must await further appropriations.

July 1, 1893, balance unexpended	$5,538.07
June 30, 1894, amount expended during fiscal year	4,882.56
July 1, 1894, balance unexpended	655.51
July 1, 1894, outstanding liabilities	147.44
July 1, 1894, balance available	508.07
Amount appropriated by act of August 17, 1894	3,500.00
Amount available for fiscal year ending June 30, 1895	4,008.07
Amount (estimated) required for completion of existing project	8,162.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	8,162.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix C 1.)

2. *Harbor of refuge at Nantucket, Mass.*—This harbor is the only one between the harbors of Marthas Vineyard (Vineyard Haven and Edgartown) and Provincetown, a distance of about 100 miles, except the small harbor of Hyannis, on the north side of Nantucket Sound. It has deep water inside, and the object of improvement is to make it a harbor of refuge for vessels plying between ports north and south of Cape Cod.

The approved project of 1880, as modified in 1885, provides for the construction of two jetties as training walls, one on each side of the harbor entrance, planned so as to allow the tidal current to assist in scouring out and maintaining a good channel, and for the completion of the work by dredging where necessary to obtain a depth of from 12 to 15 feet at low water in this channel; all at a total cost estimated in 1885 at $375,000, of which $195,000 was appropriated prior to 1894.

At the adoption of the present project no jetties existed and the channel entrance was barred by a shoal of 1.5 miles width, on which there was only 6 feet depth of water at low tide, the channel being very crooked and subject to changes in location.

The sum of $172,045.22 had been expended on this work up to June 30, 1893, by which the west jetty had been built to 3,955 feet length with full height, the east jetty had been built to 834 feet length with full height, and, after a gap of 160 feet, 1,300 feet length had been raised to half-tide level.

During the past fiscal year contracts have been made for work under the 1892 appropriation.

The balance available is to be applied to the further extension of the east jetty and raising low places in the west jetty, together with a little dredging if necessary.

July 1, 1893, balance unexpended		$22,954.78
June 30, 1894, amount expended during fiscal year		3,419.96
July 1, 1894, balance unexpended		19,534.82
July 1, 1894, outstanding liabilities	$3,570.96	
July 1, 1894, amount covered by uncompleted contracts	13,407.25	
		16,978.21
July 1, 1894, balance available		2,556.61
Amount appropriated by act of August 17, 1894		25,000.00
Amount available for fiscal year ending June 30, 1895		27,556.61
Amount (estimated) required for completion of existing project		155,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896		100,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.		

(See Appendix C 2.)

3. *Marthas Vineyard inner harbor at Edgartown, Mass.*—The inner harbor at Edgartown lies in the northern part of the waterway or strait that separates Chappaquiddick Island from the east end of Marthas Vineyard. It extends southward about 1½ miles from Chappaquiddick Point opposite Edgartown, and averages about one-fifth of a mile in width.

This harbor is so completely landlocked as to form a safe harbor of refuge for small vessels, but the contracted width of the entrance and the resulting velocity of the tidal currents make it difficult to pass through.

The approved project of 1889 provides for the removal to 10 feet depth at low water of a "middle ground" shoal in the central part of the inner harbor, at a total cost estimated in 1893 at $7,000, of which $4,500 was appropriated prior to 1894.

At the adoption of the present project the middle ground shoal carried only about 6 feet depth of water and was a very troublesome obstruction.

The sum of $4,267.61 had been expended on this work up to June 30, 1893, by which about three-quarters of the shoal had been dredged to full depth.

During the year operations were necessarily restricted to minor office work and care of property.

Further dredging must await further appropriations.

July 1, 1893, balance unexpended	$232.39
June 30, 1894, amount expended during fiscal year	224.28
July 1, 1894, balance unexpended	8.11
July 1, 1894, outstanding liabilities	6.70
July 1, 1894, balance available	1.41
Amount appropriated by act of August 17, 1894	2,500.00
Amount available for fiscal year ending June 30, 1895	2,501.41

(See Appendix C 3.)

4. *Harbor at Vineyard Haven, Mass.*—Vineyard Haven is a deep indentation in the northern shore of the island of Marthas Vineyard, on the southern side of Vineyard Sound. The approved project of 1887, as modified in 1889, provides for the protection of the "Chops" (or headlands) from erosion and the intervening harbor from being filled by the eroded material; the whole to be done by means of stone sea walls and jetties to be built along the beach in front of the bluffs at both headlands. The total cost was estimated in 1889 at $60,000, of which $42,500 was appropriated prior to 1894.

At the adoption of the present project the headlands were gradually wearing away and the adjacent parts of the harbor were shoaling. No protection works were in existence.

The sum of $35,774.84 had been expended on this work up to June 30, 1893, by which there had been built a sea wall of 450 feet length and a jetty of 50 feet length at the East Chop, and a sea wall of 400 feet length, three jetties of from 80 to 296 feet length, a wharf, and a short breakwater of 60 feet length at the West Chop.

During the past fiscal year work on the sea walls under old contracts was completed at the West Chop and commenced at the East Chop.

The balance available will be applied to continuing the work of protection at both chops.

July 1, 1893, balance unexpended		$6,725.16
June 30, 1894, amount expended during fiscal year		4,620.67
July 1, 1894, balance unexpended		2,104.49
July 1, 1894, outstanding liabilities	$457.12	
July 1, 1894, amount covered by uncompleted contracts	977.60	
		1,434.72
July 1, 1894, balance available		669.77
Amount appropriated by act of August 17, 1894		7,500.00
Amount available for fiscal year ending June 30, 1895		8,169.77
Amount (estimated) required for completion of existing project		10,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896		10,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

(See Appendix C 4).

5. *Wareham Harbor, Massachusetts.*—The object of the improvement is to deepen and widen the channel leading from Buzzards Bay to Wareham. The commerce of Wareham is carried on in sailing vessels, and the channel is to be made a beating channel for such vessels. Another object of the improvement is the raising of Long Beach.

The approved project of 1880 provides for the deepening and widening of the channel from Buzzards Bay to Wareham, so as to obtain 9 feet depth at low water over 250 feet width from the entrance up to Barneys Point, thence the same depth over 350 feet width up to the lower wharves of the city, and thence the same depth and 200 feet width opposite the city front; and for the raising and protecting of Long Beach (the eastern headland of the entrance) so as to prevent the erosion of this beach and the shoaling of the adjacent parts of the channel and harbor; all at a total cost estimated in 1887 at $56,236, of which all was appropriated prior to 1894.

At the adoption of the present project the headland of Long Beach was wearing off and the adjacent parts of the channel and harbor were shoaling. The channel was narrow and crooked and limited to 9 feet depth at low water.

The sum of $51,240.25 had been expended on this work up to June 30, 1893, by which the channel had been deepened to half width and full depth of 9 feet in its upper portion, and to less width in its lower portions, and the sand spit had been partly protected by catch-sand fences and brush and stone work.

The ruling depth of the approaches to Wareham had been increased from 7 to 9 feet, and the channel greatly widened in all the reaches. Vessels can be carried to Wareham with larger draft than formerly. The increase in width of channel had been a great help to all vessels in beating in and out of the harbor.

During the past fiscal year work of dredging has been carried on by hired labor and the use of the Government plant, securing nearly full widths in the upper portions, and about two-thirds widths in the lower portions of the channel.

Further dredging must await further appropriations.

July 1, 1893, balance unexpended	$4,995.75
June 30, 1894, amount expended during fiscal year	4,520.97
July 1, 1894, balance unexpended	474.78
July 1, 1894, outstanding liabilities	66.74
July 1, 1894, balance available	408.04

(See Appendix C 5.)

6. *New Bedford Harbor, Massachusetts.*—New Bedford Harbor is an estuary of Buzzards Bay, and is the port of the cities of New Bedford and Fair Haven.

Before improvement the channel had a depth of about 12½ feet at mean low water. Old projects of 1874 and 1877 provided for a channel 300 feet wide and 15 feet deep at mean low water from the deep water just above Palmer Island to the wharves at New Bedford. This work was completed in 1877 at a cost of $20,000.

The approved project of 1887 provides for the deepening, widening, and straightening of the channel from Buzzards Bay to New Bedford, so as to obtain 18 feet depth at low water over 200 feet width and over its entire length, at a total cost estimated in 1887 at $35,000, of which $27,500 was appropriated prior to 1894.

At the adoption of the present project the channel was winding and only about 15 feet deep.

The sum of $20,263.87 had been expended on this work up to June 30, 1893, by which the straight channel had been completed on its western side to 15 feet depth with 80 feet width over its entire length; and a slightly crooked channel of 80 feet width with 18 feet depth also existed over the same distance, wandering a little from the projected channel.

During the past fiscal year work of dredging under old contracts was commenced and completed, securing full widths and depths in the upper harbor and over half widths in lower portions.

Further dredging must await further appropriations.

July 1, 1893, balance unexpended	$7,236.13
June 30, 1894, amount expended during fiscal year	6,555.57
July 1, 1894, balance unexpended	680.56
July 1, 1894, outstanding liabilities	51.80
July 1, 1894, balance available	628.76
Amount appropriated by act of August 17, 1894	7,500.00
Amount available for fiscal year ending June 30, 1895	8,128.76

(See Appendix C 6.)

7. *Canapitsit Channel, Massachusetts.*—This waterway lies about 20 miles south of New Bedford, running between the islands of Cuttyhunk and Nashawena, and connecting the waters of Vineyard Sound and Buzzards Bay.

The object of the improvement is to make this channel safe for the use of light-draft sail boats, and also especially of the surf boats belonging to the life-saving station of this dangerous locality.

The approved project of 1891 provides for the widening and deepening of the present channel from Vineyard Sound to the ocean between the islands of Nashawena and Cuttyhunk, Massachusetts, so as to secure a depth of 6 feet at low water with a least width of 150 feet over its entire length, at a total cost estimated in 1893 at $9,800, of which $4,800 had been appropriated prior to 1894.

At the adoption of the present project the sand shoals, and especially the numerous bowlders, made this passage specially dangerous to the life-saving-station boats and other shallow-draft row and sail boats.

The sum of $1,539.54 had been expended on this work up to June 30, 1893, by which a channel of about 66 feet width and at least 5 feet depth at low water had been cut entirely across the shoal, completing about half of the proposed work.

During the past fiscal year a few more of the worst bowlders were blasted from the cleared channel.

Further work in the field must await further appropriations.

July 1, 1893, balance unexpended	$3,260.46
June 30, 1894, amount expended during fiscal year	3,140.76
July 1, 1894, balance unexpended	119.70
July 1, 1894, outstanding liabilities	41.01
July 1, 1894, balance available	78.69
Amount appropriated by act of August 17, 1894	5,000.00
Amount available for fiscal year ending June 30, 1895	5,078.69

(See Appendix C 7.)

8. *Taunton River, Massachusetts.*—This river rises in Norfolk County, Mass., and empties into Narragansett Bay at Fall River. The object of the improvement is to deepen and widen the channel leading to the city of Taunton, at the head of navigation, so that vessels of 11 feet draft can reach the city at high water.

In its original condition the channel was narrow and obstructed by bowlders, and from Berkley bridge to Taunton the depth was not, in places, more than 5 feet at mean high water. A vessel of 30 tons burden was as large as could go up to Taunton.

From 1870 to 1879 $63,000 was appropriated to secure 9 feet depth at high water. This work was completed in 1879.

The approved project of 1880 provides for the widening and deepening of the river so as to secure a channel of at least 12 feet depth at high water, with 100 feet width from its mouth up to Berkley bridge (above Dighton), thence 12 feet depth with 80 feet width (100 feet width at bends) up to Briggs Shoal, thence 11 feet depth with 80 feet width up to the shipyard, thence 11 feet depth with 60 feet width up to Weir bridge, Taunton; all at a total cost estimated in 1893 at $125,000, of which $108,000 was appropriated prior to 1894.

At the adoption of the present project the channel was limited to 9 feet at high water, and was too narrow and too much obstructed by bowlders for easy navigation by the craft making use of it.

The sum of $107,945.22 had been expended on this work up to June 30, 1893, by which a large part of the proposed work had been done, especially at the places most complained of by the vessels using this river. Vessels of 11 feet draft could reach Taunton, at the head of navigation.

During the past fiscal year operations were necessarily restricted to minor office work and care of property.

There remains to complete the existing project, widening and deepening at a few points above the bridge and the removal of a small amount of ledge rock.

Further dredging must await further appropriations by Congress.

July 1, 1893, balance unexpended	$51.78
June 30, 1894, amount expended during fiscal year	2.89
July 1, 1894, balance unexpended	51.89
Amount appropriated by act of August 17, 1894	5,000.00
Amount available for fiscal year ending June 30, 1895	5,051.89
Amount (estimated) required for completion of existing project	12,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	12,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix C 8.)

9. Pawtucket River, Rhode Island.—This river, otherwise called Seekonk River, is the upper portion of Providence River, and extends from Pawtucket to Providence. Before improvement the channel in the river had a ruling depth of about 5 feet at mean low water.

Between 1867 and 1882 $52,000 were appropriated to dredge the channel to 7 feet depth. This work was finished in 1876.

The approved project of 1883 provides for the deepening of the river so as to secure a channel of at least 12 feet depth at low water, with 100 feet width from its mouth at Providence up to opposite Grant & Co.'s wharf at Pawtucket, and thence 12 feet depth with 40 feet width through a stone ledge for a short distance farther to Pawtucket bridge; all at a total cost estimated in 1883 at $382,500, of which $180,000 was appropriated prior to 1894.

At the adoption of the present project the channel was narrow and only about 5 feet deep.

The sum of $145,551.77 had been expended on this work up to June 30, 1893, by which the shoalest places had been improved and about nine-tenths of the needed work done, securing a channel about 12 feet deep and from 40 to 100 feet wide (the greater portion being 100 feet wide) up to above the lower wharves of the city of Pawtucket.

This completed portion of the channel had been already a great benefit to the commerce of the river.

During the past fiscal year work of dredging under old contracts was commenced and completed, securing full widths and depths up to the rock ledge; and by hired labor and the Government plant the worst parts of the ledge were removed.

The work yet to be done is to straighten the channel in its lower portions and to deepen the channel through the ledge to full depth with a width of 40 feet.

The balance available will be applied to continuing the improvement.

July 1, 1893, balance unexpended	$34,448.23
June 30, 1894, amount expended during fiscal year	23,424.74
July 1, 1894, balance unexpended	11,023.49
July 1, 1894, outstanding liabilities	149.28
July 1, 1894, balance available	10,874.21
Amount appropriated by act of August 17, 1894	25,000.00
Amount available for fiscal year ending June 30, 1895	35,874.21
Amount (estimated) required for completion of existing project	177,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	100,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

(See Appendix C 9.)

10. Providence River and Narragansett Bay, Rhode Island.—The object of this improvement is to furnish a wide and deep channel for foreign and coastwise commerce from the ocean to Providence.

Before the improvement of the river was commenced in 1853 many shoals obstructed navigation, and at one point in the channel, a place called "The Crook," the available low-water depth was but 4½ feet. Between 1852 and 1873 $56,500 was appropriated to secure first 9 and then 12 feet depth of channel. This work was finished in 1873.

The approved project of 1878, as modified in 1882, provides for the deepening of the river and the deepening and widening of its anchorage basins, so as to secure a channel of at least 25 feet depth at low water with 300 feet width from the deep water of Narragansett Bay up to Providence, R. I., and so as to secure anchorage basins of 20 feet depth with 600 feet width, 18 feet depth with 725 feet width, 12 feet depth with 940 feet width, and 6 feet depth with 1,060 feet width, from Fox to Field Point; all at a total cost estimated in 1882 at $675,000, of which $610,000 was appropriated prior to 1894.

At the adoption of the present project the channel was limited to 12-foot depths, and the anchorage areas were much too small and shallow for the craft seeking them.

The sum of $564,098.28 had been expended on this work up to June 30, 1893, by which all the 25-foot channels, most of the 20-foot anchorages, and a part of the 18-foot anchorages had been dredged, this being about five-sixths of all the proposed work.

During the past fiscal year work of dredging under old contracts was continued and completed, securing full depths and widths over all the dredgeable portions of the anchorage basin; and then by the Government plant and hired labor, the few remaining places were cleared of ledge rock down to full depths.

There is required for the completion of existing project a final redredging of the main channel where it has shoaled since 1882.

Further dredging must await further appropriations.

July 1, 1893, balance unexpended	$45, 901. 72
June 30, 1894, amount expended during fiscal year	43, 358. 68
July 1, 1894, balance unexpended	2, 543. 04
July 1, 1894, outstanding liabilities	1, 102. 49
July 1, 1894, balance available	1, 440. 55
Amount appropriated by act of August 17, 1894	17, 500. 00
Amount available for fiscal year ending June 30, 1895	18, 940. 55
Amount (estimated) required for completion of existing project	47, 500. 00
Amount that can be profitably expended in fiscal year ending June 30, 1896	47, 500. 00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix C 10.)

11. Removal of Green Jacket Shoal, Providence River, Rhode Island.—This shoal is in that part of Providence River which constitutes the harbor of Providence. It lies off the wharves, on the south front of the city, and occupies a part of the harbor that is required for anchorage purposes, covering an area of about 18 acres between the 15-foot curves, and about 30 acres in all.

The approved project of 1885 provides for the removal to 25 feet depth, at low water, of a middle-ground shoal of about 30 acres area, in Providence River, opposite the city, the portion to be removed to be at least 200 feet distant from the harbor lines of the city; all at a total cost estimated in 1885 at $112,346, of which $89,250 was appropriated prior to 1894.

At the adoption of the present project the shoal in many places carried only 1 foot of water, and was a very troublesome obstruction.

The sum of $79,574.37 had been expended on this work up to June 30, 1893, by which 18 acres out of the original 30 of this shoal had been removed to a depth of 25 feet at mean low water, making an important addition to the anchorage facilities of Providence Harbor.

During the past fiscal year work of dredging under old contracts was commenced and completed, securing 16 feet depth over all the central portions of the shoal and 20 feet depth over all the main channel way.

Further dredging, to full 25 feet depth, must await further appropriations.

July 1, 1893, balance unexpended	$9, 675. 63
June 30, 1894, amount expended during fiscal year	9, 192. 65
July 1, 1894, balance unexpended	482. 98
July 1, 1894, outstanding liabilities	18. 66
July 1, 1894, balance available	464. 32
Amount appropriated by act of August 17, 1894	7, 500. 00
Amount available for fiscal year ending June 30, 1895	7, 964. 32
Amount (estimated) required for completion of existing project	15, 596. 00
Amount that can be profitably expended in fiscal year ending June 30, 1896	15, 596. 00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix C 11.)

12. Newport Harbor, Rhode Island.—This harbor is at the main entrance to Narragansett Bay, and all the year it serves as an easily accessible harbor of refuge to foreign and coastwise commerce.

Before improvement the capacity of the inner harbor was limited by shoals, and it was not adequate to the number and size of the vessels seeking it for refuge. The southern or main entrance was obstructed by a bar which stretched out from Goat Island, and the general business wharves of the city could not be reached at low tide by vessels drawing more than 8 feet.

Between 1873 and 1875 $28,500 was appropriated to secure 12 feet depth in the harbor. This work was completed in 1876.

The approved project of 1880, as modified in 1882-'83-'84, and 1890, provides for the widening and deepening of the channel from Narragansett Bay into Newport, so as to secure 15 feet depth at low water with at least 750 feet width; for the extension of the 13-foot depth and 10-foot depth anchorage basins; for the partial cutting off of the shoal spit at the southern end of Goat Island, and for the construction of jetties on the western shore of Goat Island so as to protect the end of this island from erosion, and to prevent the drift of sand, etc., around the island into the adjacent parts of the channel and harbor; all at a total cost estimated in 1890 at $156,200, of which $129,500 was appropriated prior to 1894.

At the adoption of the present project this harbor was limited to 12 feet depth at low water, and its anchorage area was too small for the craft seeking harborage at this place during the summer and all the year during storms.

The sum of $105,143.03 had been expended on this work up to June 30, 1893, by which the 15-foot channels and 13-foot anchorage basins had been dredged, and one jetty, 133 feet long, had been built westward from Goat Island. The southern entrance had been completed for vessels of 15 feet draft, and of the total area to be dredged within the harbor (about 90 acres) about 66 acres had been completed.

During the past fiscal year work of dredging under old contracts was commenced and completed, securing the complete removal of the Goat Island Spit to 15 feet depth.

The work required to complete the existing project is the excavation of a small remaining portion of the 10-foot anchorage area; also the building of additional jetties outside of Goat Island, whenever they may be required, to arrest the drift of littoral sand and gravel into the harbor entrance.

The balance available is to be applied to continuing the improvement.

July 1, 1893, balance unexpended		$24,356.97
June 30, 1894, amount expended during fiscal year		22,416.04
July 1, 1894, balance unexpended		1,940.93
July 1, 1894, outstanding liabilities	$32.28	
July 1, 1894, amount covered by uncompleted contracts	400.00	
		432.28
July 1, 1894, balance available		1,508.65
Amount appropriated by act of August 17, 1894		7,500.00
Amount available for fiscal year ending June 30, 1895		9,008.65
Amount (estimated) required for completion of existing project		19,200.00
Amount that can be profitably expended in fiscal year ending June 30, 1896		19,200.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

(See Appendix C 12.)

13. Harbor of refuge at Point Judith, Rhode Island.—Point Judith is the southeastern extremity of South Kingston, R. I., and marks the southwestern entrance to Narragansett Bay. A long ledge, known as Squid Ledge, extends for nearly a mile in a south-by-easterly direction about 1½ miles west of the point.

The approved project of 1889 provides for the construction of a national harbor of refuge nearly a mile square at this point by means of stone breakwaters, planned so as to give protection against easterly, southerly, and westerly storms, the mainland itself forming a protection on the north, all at a total cost estimated in 1889 at $1,250,000, of which $250,000 was appropriated prior to 1894.

By the act of July 13, 1892, authority was given to the Secretary of War to make contracts for the completion of the project, on the basis of the above-estimated total cost, the work to be paid for as appropriations may from time to time be made by law.

At the adoption of the project this point was a specially dangerous place for boats and tows to pass during storms and even ordinarily bad weather.

The sum of $75,347.60 had been expended on this work up to June 30, 1893, by which quarries had been opened, special plant had been built, and the breakwater had been commenced at its center, about 200 feet length raised to about low-water level, and a beacon light established thereon.

During the past fiscal year work of placing stone under old contracts was commenced and continued, by which about 100,000 tons of stone has been placed in the breakwater, raising about 2,000 feet length up to about low-water level.

It is proposed to apply the balance available and the appropriation asked for to continuing the construction of the breakwater.

July 1, 1893, balance unexpended		$174,652.40
June 30, 1894, amount expended during fiscal year		87,922.58
July 1, 1894, balance unexpended		86,729.82
July 1, 1894, outstanding liabilities	$35,482.28	
July 1, 1894, amount covered by uncompleted contracts	45,154.51	
		80,636.79
July 1, 1894, balance available		6,093.03
Amount appropriated by sundry civil act of August 18, 1894		100,000.00
Amount available for fiscal year ending June 30, 1895		106,093.03
Amount (estimated) required for completion of existing project		900,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896		800,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

(See Appendix C 13.)

14. Harbor of refuge at Block Island, Rhode Island.—This island is about 14 miles east of the eastern end of Long Island and about 10 miles distant from the nearest point of the mainland.

The object of the improvement is to furnish a harbor of refuge for vessels engaged in foreign and coastwise commerce.

Before the construction of the present harbor Block Island had no harbor which afforded protection for decked vessels.

Between 1870 and 1876, $285,000 was appropriated for a breakwater for a harbor for medium-draft vessels, this work being completed in 1878. Between 1880 and 1882, $25,000 was appropriated for an inner basin and the protection of the shore next the breakwater, this work being completed in 1884. In 1884, $15,000 was appropriated for additions to the old breakwater, this money being so spent in 1884–'85.

The approved project of 1884, as modified in 1888, provides for the construction of a harbor of refuge on the eastern side of the island, consisting of an enlarged inner harbor (or basin) for small vessels and an exterior harbor for large ones. The basin was to be about 800 feet square and completely inclosed except at its 100 feet-wide entrance. The exterior harbor was already formed by an old breakwater on the east and the adjacent shore on the south and west; but an old gap near the end of this breakwater was to be filled up. The project covers the construction of the stone sea walls of the enlarged inner harbor ($46,000) the repair of the old breakwater ($24,000) and a little dredging ($5,000) along the western side of the old breakwater and also inside the harbor; all at a total cost estimated in 1888 at $75,000, of which $74,000 was appropriated prior to 1894.

At the adoption of the present project, this harbor was neither large enough nor well enough protected for the proper harborage of the craft seeking refuge at this place during storms and bad weather.

The sum of $51,621.78 had been expended on this work up to June 30, 1893, by which the gap in the old breakwater had been filled up so as to make the breakwater of 1,900 feet total length; the north sea wall had been built to 170 feet length with full height, then came a gap of 190 feet length, then 130 feet length to full height, then 100 feet length to high-water level, and then 150 feet length to low-water level; the west sea wall had been started for 50 feet at its shore end; and the shoal west of the breakwater had been dredged to a depth of 9 feet from the steamboat wharf to within 100 feet of the north wall.

During the past fiscal year work of placing stone under old contracts was commenced and completed, and work of removing old jetties and scattered bowlders, and of strengthening weak places in the sea walls and old breakwater was also commenced and completed, securing the completion of the harbor walls except as to pier heads at the harbor entrance.

The balance on hand will be applied, under the existing project, to the construction of the pier heads and to strengthening the existing sea walls at their weakest points.

July 1, 1893, balance unexpended	$22,378.22
June 30, 1894, amount expended during fiscal year	19,892.66
July 1, 1894, balance unexpended	2,485.56
July 1, 1894, outstanding liabilities	422.82
July 1, 1894, balance available	2,062.74
Amount appropriated by act of August 17, 1894	2,500.00
Amount available for fiscal year ending June 30, 1895	4,562.74

(See Appendix C 14.)

15. *Pawcatuck River, Rhode Island and Connecticut.*—The navigable part of the Pawcatuck River extends from the town of Westerly to Little Narragansett Bay, and the object of the improvement is to deepen and widen this channel.

Before improvement the channel was crooked and obstructed by numerous shoals, on some of which there was but 1¼ feet of water at mean low water.

Between 1871 and 1876 $50,000 was appropriated for the excavation of a channel 5½ feet deep at mean low water and 75 feet wide below the wharves, and from 35 to 40 feet wide between the upper and lower wharves, this work being completed in 1876.

The approved project of 1885 provides for the deepening and widening of the river so as to secure a channel of at least 8 feet depth at low water, with 100 feet width from its mouth up to the lower wharves of Westerly, and thence a channel of the same depth with about 40 feet width up to the upper wharves of the city; all at a total cost estimated in 1891 at $42,400, all of which was appropriated prior to 1894.

At the adoption of the present project the channel was limited to 5.5 feet depth, over 75 feet width below the city, and the same depth over 35 feet width opposite the city; and rock ledges covered the channel at several points.

The sum of $39,253.25 had been expended on this work up to June 30, 1893, by which the 8-foot channel had been completed from deep water upward for full width to within a half mile of the city, and for partial width for the remaining distance; and the rock ledge obstructions had been removed from the channel below the city.

During the past fiscal year work of rock removal under the Government force and plant was commenced and completed, securing the removal of all loose bowlders and ledge rock from the channel way opposite the city.

The balance available will be applied to the extension of the channel according to the project.

July 1, 1893, balance unexpended	$3,146.75
June 30, 1894, amount expended during fiscal year	1,980.67
July 1, 1894, balance unexpended	1,166.08
July 1, 1894, outstanding liabilities	61.37
July 1, 1894, balance available	1,104.71
Amount appropriated by act of August 17, 1894	6,000.00
Amount available for fiscal year ending June 30, 1895	7,104.71

(See Appendix C 15.)

16. *Harbor of refuge at Stonington, Conn.*—Stonington Harbor lies on the north side of the eastern entrance from the ocean into Long Island Sound, and its breakwaters are for the purpose of making the harbor a harbor of refuge for vessels entering and leaving this eastern entrance of the sound. Stonington Harbor originally was an open bay, unprotected from southerly storms and obstructed by a shoal having a low-water depth of but 6 feet at the shoalest part. Between 1827 and 1831 about $37,000 was spent in constructing piers or breakwaters in the inner harbor for the protection of the general harborage. Between 1871 and 1873 $46,166 was appropriated for a survey of the harbor and for dredging the harbor to 12 feet depth, this work being finished in 1875. Between 1875 and 1879 $112,500 was appropriated for the construction of a western breakwater about 2,000 feet long, extending to 18 feet depth of water, and for dredging the harborage to 12 feet depth inside this breakwater, this work being completed in 1880.

The approved project of 1880 provides for the construction of an eastern breakwater as a protection to the outer harbor, this breakwater, about a half mile long, to extend from the vicinity of Bartletts Reef to the vicinity of the Middle Ground Shoal, or until it gives sufficient protection to the harbor against southerly winds; all at a total cost estimated in 1884 at $143,000, all of which was appropriated prior to 1894.

At the adoption of the present project the harbor had no eastern breakwater.

The sum of $131,062.32 had been expended on this work up to June 30, 1893; this expenditure resulted in the extension of this eastern breakwater to a total length of 2,377 feet.

During the past fiscal year minor surveys were made and bids solicited for the further extension of the breakwater.

The balance on hand will be expended in extending the eastern breakwater.

July 1, 1893, balance unexpended	$11,937.68
June 30, 1894, amount expended during fiscal year	1,267.01
July 1, 1894, balance unexpended	10,670.67
July 1, 1894, outstanding liabilities	249.26
July 1, 1894, balance available	10,421.41
Amount appropriated by act of August 17, 1894	5,000.00
Amount available for fiscal year ending June 30, 1895	15,421.41

(See Appendix C 16.)

17. Removing sunken vessels or craft obstructing or endangering navigation.—a. Wreck of steam yacht Alva.—This steam yacht, on a pleasure trip, was sunk by collision in July, 1892, in the middle of Pollock Rip Channel, eastern entrance to Nantucket Sound, Massachusetts. Her owners were allowed the two months guaranteed them by law in which to remove her. After this time the wreck was duly advertised and her removal awarded to the lowest bidder under contract dated December 12, work to be completed by May 14, 1893. Unusual stress of weather during the winter caused this time to be extended until July 14, 1893. Work was finally finished and final inspection made July 5, 1893.

b. Wreck of old stone schooner at Monomoy Point.—This schooner, loaded with stone, sunk several years ago on the southern edge of Shovelful Shoal, Monomoy Point, Southern Cape Cod, Massachusetts, had, in 1893, become a dangerous obstruction to navigation. The wreck was removed by the Government force and plant, work being completed in July, 1893.

c. Wreck of schooner Nellie V. Rokes.—This schooner, loaded with stone, sunk in 1890 about 0.5 mile southeast of the Monomoy Life-Saving Station, Southern Cape Cod, Massachusetts, had in 1893 become a dangerous obstruction to navigation. The wreck was removed by the Government force and plant, work being completed in August, 1893.

d. Wreck of schooner Rogers.—This schooner, loaded with coal, was stranded, in April, 1893, in the slue of Handkerchief Shoal, about 1.5 miles southwest of Monomoy Point, Southern Cape Cod, Massachusetts. The wreck was removed by the Government force and plant, work being completed in July, 1893.

e. Wrecks in Vineyard Haven, Massachusetts.—Seven old wrecks, of several years' age, were reported in July, 1893, as lying in Vineyard Haven Harbor and still obstructing its navigation and endangering the safety of its shipping. They were all removed by the Government force and plant, work being completed in August, 1893.

f. Wreck of schooner Acacia.—This vessel, wrecked in August, 1893, was reported the same month as lying about 6 miles east-southeast of Chatham, Mass., its masts endangering the safety of other craft. The wreck was removed by the Government plant and force, work being completed in October, 1893.

g. Wreck of barge N. and W., No. 4.—This vessel, loaded with coal, was sunk by collision in August, 1893, in Providence River, Rhode Island. The wreck was removed by its owners, work being completed prior to the expiration of the two months' limit allowed them by law.

h. Wreck of schooner John P. Kelsey.—This vessel, on fire, sunk on or before September 23, 1893, about 1.5 miles east of Handkerchief light-ship, Nantucket Sound, Massachusetts. The wreck was removed by the Government plant and force, work being completed in January, 1894.

i. Wreck of schooner G. M. Farnsworth.—This vessel, sunk and abandoned several years ago on the Common Flats, Old Chatham Roads, Massachusetts, was reported in October, 1893, as still endangering navigation. The wreck was removed by the Government plant and force, work being completed in January, 1894.

j. Wreck of schooner Annie W. Akers.—This vessel, sunk in November, 1893, about 200 yards southwest of the railroad wharf at Hyannis Harbor, Massachusetts. The wreck was removed by the Government plant and force, work being completed in March, 1894.

k. Wreck of schooner Stephen Raymond.—This vessel sunk in November, 1893, about 35 yards west of the railroad wharf at Hyannis Harbor, Massachusetts. The wreck was removed by the Government plant and force, work being completed in February, 1894.

l. Wreck of schooner Katie Mitchell.—This vessel sunk in August, 1893, on a bar about 3 miles southeast from Hyannis, Mass. The wreck was removed by the Government plant and force, work being completed in February, 1894.

m. Wreck of schooner Franklin.—This vessel sunk in November, 1893, on Bearses Shoal, about 0.5 mile southeast by east from Monomoy Point light-house, Mass. The wreck was removed by the Government plant and force, work being completed in March, 1894.

n. Wreck of schooner Laura E. Messer.—This vessel sunk in January, 1894, on Bearses Shoal, about 1.5 miles east from Monomoy Point light-house, Mass. During the two months' delay required by law the wreck was broken up and scattered by the ocean so as to no longer be an obstruction to navigation.

o. Wreck of schooner Asa H. Pervere.—This vessel sunk several years ago, about 2.4 miles south-by-west from Chatham lights, close to Monomoy Beach, Massachusetts, was reported in March, 1894, as still endangering navigation. The wreck was removed by the Government plant and force, work being completed in March, 1894.

p. Wreck near Browns Ledge.—Various reports received from January to May, 1894, indicated the presence of a wreck somewhere near Browns Ledge, southwest of Cuttyhunk and west of Marthas Vineyard, Mass. This wreck was scattered by dynamite by the U. S. Navy cruiser *Vesuvius* in June, 1894, leaving nothing further to be done by the War Department.

q. Wreck of schooner L. F. Hopkins.—This wreck, on fire, sunk across the channel of the river at Pawtucket, R. I., on May 16, 1894. Preparations have been made to commence her removal on July 16, at the end of the two months' delay required by law.

r. Wreck near Parkers River.—This wreck was reported in June, 1894, as lying somewhere near the shore of Nantucket Sound, Massachusetts, between Parkers River and Bass River. Preparations are being made for its removal.

The cost of work on the wrecks removed during the year was $11,544.74.

(See Appendix C 17.)

IMPROVEMENT OF CONNECTICUT RIVER AND OF RIVERS AND HARBORS IN CONNECTICUT AND NEW YORK TRIBUTARY TO LONG ISLAND SOUND, AND ON SOUTHERN SHORE OF LONG ISLAND.

This district was in the charge of Lieut. Col. Henry M. Robert, Corps of Engineers, having under his immediate orders Lieut. Thomas H. Rees, Corps of Engineers, to August 22, 1893, and Lieut. W. E. Craighill, Corps of Engineers, since November 20, 1893.

1. *Mystic River, Connecticut.*—This is a tidal river about 4 miles in length, extending northward from Fishers Island Sound. Its natural depth for the lower 2 miles was 15 feet or more at low tide, in a very crooked and narrow channel; thence for a mile farther, to the village of Mystic, the depth shoaled to about 9 feet.

Above Mystic there has been little navigation. In 1888 an examination of the river was made, and subsequently a project was adopted for dredging to carry the depth of 15 feet at mean low water, with width of 100 feet, up to the highway bridge, and to widen five bends in the stream at an estimated cost of $30,000.

Up to July 1, 1893, $16,350.97 had been expended on this improvement in dredging to make an available depth of 15 feet at mean low water up to Mystic, where the previous depth had been 9 feet; the widening of the upper of the five bends had been completed, and the second nearly completed; the sharp bend at the mouth of the river had also been widened by 25 to 75 feet.

During the past fiscal year work at the second bend was completed, and an additional width of 25 feet was dredged for a length of 800 feet at the worst part of the lower bend opposite the Noank shipyards.

The total amount appropriated for this improvement is $23,500.

Future appropriations will be applied to dredging, to widen the channel at the lower bends, as provided in the project.

July 1, 1893, balance unexpended	$3, 649. 03
June 30, 1894, amount expended during fiscal year	3, 378. 64
July 1, 1894, balance unexpended	270. 39
Amount appropriated by act of August 17, 1894	3, 500. 00
Amount available for fiscal year ending June 30, 1895	3, 770. 39
Amount (estimated) required for completion of existing project	6, 500. 00
Amount that can be profitably expended in fiscal year ending June 30, 1896	6, 500. 00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix D 1.)

2. *Thames River, Connecticut.*—This river is a tidal stream extending from the city of Norwich, 15 miles south, to Long Island Sound. For 11 miles above its mouth the depth ranges from 13 to 80 feet.

Until 1889, improvements were confined to a stretch of 3½ miles below Norwich, in which the most troublesome bars lay. In 1829 the channel depth over these bars was about 6 feet at mean low water.

In 1836 a project was adopted for making a channel 100 feet wide and 14 feet deep at mean high water (11 feet at low water) by dredging and by building piers.

In 1878 a channel 14 feet deep at low water was projected, and in 1882 a modification was adopted providing for a channel 200 feet wide and 14 feet deep at mean low water, to be obtained by dredging and by building five dikes or training walls along the outer sides of the channel curves. The estimated cost was $208,080, and a balance of $20,000 from previous appropriations was then available. In 1888 the project was extended to include making 16 feet depth as far as Allyn Point, and 14 feet from there to Easter Point at an additional cost of $40,000.

Under the provisions of the river and harbor act of July 13, 1892, $10,000 of the appropriation for Thames River was authorized to be expended in the improvement of Shaws Cove, New London, and the total estimated cost of this additional work, $48,000, has been added to the estimate required for completion of the existing project for the improvement of the river. The original depth in this cove was from 2½ to 8 feet at mean low water, and the channel was narrow and crooked. The project provides for making a channel 100 feet wide and 12 feet deep, with an anchorage basin of the same depth, about 800 by 400 feet.

Up to July 1, 1893, three of the proposed dikes had been completed, and the fourth one nearly so; and the channel had an available depth of 14 feet up to Mohegan (3 miles below Norwich) and thence to Norwich a depth of 12 feet at mean low water. The channel in Shaws Cove had been made the full length and depth with width of 60 feet, and the anchorage basin had been begun.

The total amount expended on this improvement up to July 1, 1893, including outstanding liabilities, was $389,492.91.

During the past fiscal year 37,715 cubic yards was dredged, extending the channel of 14 feet depth up to the "Sand Pier" (about 1½ miles below Norwich) with width of 100 feet. No work was done in Shaws Cove.

The total amount appropriated since 1821 for improving this river, including Shaws Cove, is $404,300.

Future appropriations will be applied to dredging to complete the 14-foot channel to Norwich, and to complete the projected anchorage basin in Shaws Cove.

July 1, 1893, balance unexpended	$24,051.45
June 30, 1894, amount expended during fiscal year	21,090.41
July 1, 1894, balance unexpended	2,961.04
Amount appropriated by act of August 17, 1894	12,500.00
Amount available for fiscal year ending June 30, 1895	15,461.04
Amount (estimated) required for completion of existing project	81,100.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	50,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix D 2.)

3. Connecticut River, Massachusetts and Connecticut.—Above Hartford.—From Holyoke, Mass., 34 miles above Hartford, down to Enfield Falls or Rapids, a distance of 18 miles, there is a fair channel 4 to 5 feet deep.

Enfield Rapids extends about 5 miles over a rocky and uneven bed, with a total fall of 32 feet. From the foot of Enfield Rapids to Hartford, a distance of 11 miles, the river's bed is broad and sandy, with a channel from 2 to 5 feet deep at low water.

Several years ago the Connecticut River Company constructed a small canal around Enfield Rapids, through which boats of 3 feet draft and 80 feet length can pass.

The several projects under which work has been done have been for dredging at Barbers Landing and for wing dams. In 1878 plans and estimates were submitted for construction of a canal 8 feet deep around Enfield Rapids. These estimates were revised in 1880. The estimated cost of the canal was $1,322,805. It was not considered advisable to commence construction with a less sum than $450,000, which has not yet been appropriated.

Up to the close of the present fiscal year $100,000 has been appropriated for this part of the river, of which $91,059.70 has been expended.

All the work done has been dredging and the construction and repair of seven wing dams.

No work has been done during the past fiscal year.

The last appropriation for this part of the river was made in 1880, and the last work done was repair of wing dams in 1886. Except the fixing and defining of the channel by wing dams, the results of the improvement so far made have not been permanent.

The funds on hand from previous appropriations are sufficient for such repairs and temporary improvement as may be needed during the ensuing fiscal year. No other work is at present contemplated.

July 1, 1893, balance unexpended	$8,940.30
July 1, 1894, balance unexpended	8,940.30

Connecticut River below Hartford.—Between Hartford and Long Island Sound, a distance of 50 miles by course of channel, the depth on the bars was formerly 5 feet at low water, the worst places being between Hartford and Middletown, a distance of 19 miles, and at Saybrook Bar at the mouth of the river. Dredging was carried on and small wing dams were constructed by private parties and by a State corporation up to 1868, with no permanent benefit.

In 1868 a project for improvement by the United States was submitted, under which a pile dike was built at Hartford, and annual dredging done on the bars below Hartford until 1883.

In 1873 a project for the construction of three jetties on Saybrook Bar was adopted. Two of these have been built; the third will probably not be required.

In 1880 a project for permanent improvement of six of the worst bars between Hartford and Middletown was adopted: it contemplated building riprap wing dams, rectifying the banks, and protecting the caving banks by mattresses, at a total estimated cost of $330,487. It was afterwards found necessary to extend the project to include annual dredging at these and other bars, and the extension and repairs of the Saybrook jetties.

Two of the contemplated works have been built, a training wall at Hartford Bar and a wing dam at Glastonbury Bar, their total cost being $40,715.34. In addition to the work included in the estimate of $330,487, the east and west jetties at Saybrook have been extended and repaired, and a channel 130 feet wide and 12 feet deep has been dredged between them, and from $5,000 to $10,000 has been annually expended in dredging to maintain a depth of 9 feet on the bars between Hartford and Saybrook.

Experience has shown that, on account of the frequency and height of freshets in this river, the permanent works projected in 1880 would be inadequate to maintain the desired depth, or even to materially reduce the amount of dredging annually required. Therefore in December, 1887, a new project was adopted confining future operations to the completion of the Saybrook jetties to a height of 5 feet above high water, with a top width of 6 feet, and widening the channel between the jetties to 400 feet, with a depth of 12 feet at mean low water, at an estimated cost of $80,000, with annual dredging to maintain a 9-foot channel between Hartford and Long Island Sound, at an average cost of $10,000 per year. In 1890 an extension of the project was adopted to provide for raising the Hartfort Dike to about 15 feet above low-water level, at an additional estimated cost of $50,000, making the total estimated cost for the revised project now in force $130,000 for permanent work, and $10,000 annually for maintaining the navigable channel by dredging.

Under the existing project, up to July 1, 1893, no permanent work had been done, the available funds having been required for dredging to maintain the navigable channel.

Of the permanent works built before the adoption of the existing project (in 1887) the Hartford Dike and jetties at Saybrook are in good condition; the jetties have secured the permanence of the entrance channel, and the dike has partly secured the channel at Hartford Bar; the Glastonbury Dike is mostly covered by sand. The channel at the entrance retains nearly full width and depth.

The total amount expended by the United States for this improvement from its beginning in 1836 to July 1, 1893, including liabilities then outstanding, was $425,710.08.

During the fiscal year dredging was done to maintain the navigable channels in the river, and work is now in progress removing the shoals which formed during the spring freshets. The appropriation of 1892 has been and will be applied wholly to annual maintenance of channels and will not reduce the estimate for completion of permanent work. Dredging early in each year to restore the channels filled by spring freshets is imperatively necessary for the commerce of this river and should be done whenever funds are available in preference to the projected permanent improvements. Since this part of the project has been definitely adopted and put in practice the river has been on the average in much better navigable condition than before.

Future appropriations will be applied to the maintenance of the 9-foot channels necessary for navigation of the river, to raising the Hartford Dike, and completing the Saybrook Jetties, and to widening the channel at Saybrook Bar.

The estimated cost of completion, reported in 1893 as $110,000, should be $130,000, the appropriation of $20,000 made by act of July 13, 1892, being applied wholly to the indispensable maintenance of channels.

July 1, 1893, balance unexpended		$16,740.03
June 30, 1894, amount expended during fiscal year		8,933.27
July 1, 1894, balance unexpended		7,806.76
July 1, 1894, outstanding liabilities	$2,987.56	
July 1, 1894, amount covered by uncompleted contracts	3,157.44	
		6,145.00
July 1, 1894, balance available		1,661.76
Amount appropriated by act of August 17, 1894		20,000.00
Amount available for fiscal year ending June 30, 1895		21,661.76
Amount (estimated) required for completion of existing project		130,000.00
Amount (estimated) required for maintenance annually		10,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896		90,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.		

(See Appendix D 3.)

4. *Harbor of refuge at Duck Island Harbor, Connecticut.*—This harbor is a broad bay on the north side of Long Island Sound, about midway between the harbors of New Haven and New London, a distance of 46 miles in the widest part of the sound where there is no sufficient harbor of refuge for general commerce. Duck Island Harbor is large enough for such use, but is naturally unprotected from storms from any southerly quarter.

By order of Congress, examinations of this harbor were made in 1883 and 1886, and subsequently a project was adopted for making it a harbor of refuge by constructing three riprap breakwaters, the west one extending westerly from Duck Island, the middle one extending northeasterly from Duck Island, the east one extending southwesterly from Menunketesuck Point to the east limit of the harbor. The total length of these breakwaters was to be 5,880 feet and their estimated cost is $463,540.

Work under this project was begun in May, 1891, and up to July 1, 1893, 1,240 linear feet of the west breakwater had been built, extending it westwardly from Duck Island to a depth of about 15 feet at mean low water. At this length it affords a limited shelter from southeast and south storms.

During the past fiscal year the work has been extended 420 linear feet, making it 1,660 feet long; its present end is in depth of 16½ feet at mean low water.

The total amount appropriated for this improvement is $90,000.

Future appropriations will be applied to continuing breakwater construction.

July 1, 1893, balance unexpended	$32,865.18
June 30, 1894, amount expended during fiscal year	31,224.50
July 1, 1894, balance unexpended	1,640.68
July 1, 1894, outstanding liabilities	22.00
July 1, 1894, balance available	1,618.68
Amount appropriated by act of August 17, 1894	30,000.00
Amount available for fiscal year ending June 30, 1895	31,618.68
Amount (estimated) required for completion of existing project	373,540.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	100,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

(See Appendix D 4.)

5. *Clinton Harbor, Connecticut.*—This harbor is 10 miles west of the mouth of the Connecticut River. Its channel runs for nearly a mile inside of a beach, through which a breach was made about the year 1840, after which the channel shoaled in two places to about 4 feet depth where it had been 8 feet deep.

The project for improvement adopted in 1882 provided for closing the breach, and, if that did not restore the channel depth, for dredging a channel 100 feet wide and 6 feet deep at mean low water through the shoals. The entire cost was estimated at $10,000. In 1893 a modification of the project was adopted, which provided for a channel of 75 feet width and reduced the total estimate for completion to $8,500.

The breach was closed by building a riprap dike across it in 1883; this dike was repaired in 1892. In 1893 a channel 6 feet deep at mean low water was dredged, with width of 85 feet through the inner bar and 75 feet through the outer bar, completing the modified project in May, 1893.

No work was done during the past fiscal year. The dike and dredged channels remain in good condition.

The project being completed, no further appropriation is required.

July 1, 1893, balance unexpended	$243.78
June 30, 1894, amount expended during fiscal year	243.78

(See Appendix D 5.)

6. *New Haven Harbor, Connecticut.*—The original available low-water depth up to the wharves in this harbor was about 9 feet.

The first project for deepening the channel provided for making it 13 feet deep, which was done in 1871. It was widened at different times until 1878, when a project was adopted for dredging a channel 16 feet deep and not less than 400 feet wide. In 1882 a project was adopted for building a dike to extend out from Sandy Point, with an arm parallel to the channel and 3,200 feet long, in order to contract the channel and maintain 16 feet depth on Fort Hale Bar, when that depth should be obtained by dredging.

Up to July 1, 1893, the shore arm and 2,089 feet of the channel arm of the Sandy Point Dike had been built; a 16-foot channel from 400 to 700 feet wide had been made and maintained all the way up the harbor to Tomlinson's bridge, except over the Fort Hale Bar, where the depth is but 13 feet.

During the past fiscal year nothing was done. The last work done in this harbor was in 1892–'93, when the channel in the upper part of the harbor was widened and shoal spots removed, affording more room in this crowded part of the harbor.

The total amount appropriated for improving this harbor since the beginning of work in 1867 is $316,000.

Future appropriations will be applied to dredging and, if necessary, to extending the dike.

July 1, 1893, balance unexpended	$270.58
June 30, 1894, amount expended during fiscal year	91.47
July 1, 1894, balance unexpended	179.11
Amount appropriated by act of August 17, 1894	10,000.00
Amount available for fiscal year ending June 30, 1895	10,179.11
Amount (estimated) required for completion of existing project	38,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	38,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix D 6.)

7. *Breakwaters at New Haven, Conn.*—In 1880 a project was adopted for making a harbor of refuge at the entrance of New Haven Harbor by construction of two riprap breakwaters; the first to be 3,300 feet long, extending northeasterly from the light-house on Southwest Ledge to Quixes Ledge; the second to be 4,200 feet long, extending northwesterly from Luddington Rock. The estimated cost was $1,311,134.

The river and harbor act of August 11, 1888, provided:

> And the Chief of Engineers may, if deemed necessary, relocate the western breakwater, and the Secretary of War is authorized, in his discretion, to expend any portion of said sum in commencing its construction.

The New Haven Harbor commissioners proposed a plan for relocation of the western breakwater, which would largely increase the anchorage afforded under the original project, and which would cost about $5,000,000.

There was no doubt of the desirability of increasing the anchorage ground, but the expenditure required by this plan was larger than the present demands of commerce seemed to warrant. A plan was suggested by the officer in charge for changing the location of the western breakwater to the southwest about 6,000 feet, and constructing a breakwater 5,000 feet long, which should start at a point 1,000 feet north, 54° east from Luddington Rock, and extend south 54° west, crossing the rock; also for constructing a smaller breakwater from the east shore towards Quixes Ledge to better protect the harbor from easterly storms, leaving an eastern entrance channel 800 feet wide and 31 feet deep. The cost of these works, in addition to the estimates of $1,311,134, would be about $840,000.

Upon appropriation of $120,000 by the river and harbor act of 1890, the modifications of project above described were adopted. Further details concerning this plan, and a sketch showing location of proposed works, are printed in the Annual Report for 1889, Part I, pp. 60 and 61; also Appendix D 6, pp. 675–685.

Up to July 1, 1893, the east breakwater, 3,450 feet long, had been completed, affording considerable shelter to the east side of the harbor, and 2,911 linear feet of the middle breakwater, overlying Luddington Rock, had been built, though not to full cross-section. During the past fiscal year the middle breakwater has been extended 255 feet, making its total length 3,166 feet; the depth at the west end of the work is 22½ feet at mean low water. At its present length the breakwater affords shelter from southeast storms to more than one-half of the harbor entrance.

The total amount appropriated for this project since its commencement is $735,000.

Future appropriations will be applied to extending and enlarging the breakwater.

July 1, 1893, balance unexpended	$87,057.18
June 30, 1894, amount expended during fiscal year	84,326.16
July 1, 1894, balance unexpended	2,731.02
July 1, 1894, outstanding liabilities	50.00
July 1, 1894, balance available	2,681.02
Amount appropriated by act of August 17, 1894	125,000.00
Amount available for fiscal year ending June 30, 1895	127,681.02
Amount (estimated) required for completion of existing project	1,416,134.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	500,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

(See Appendix D 7.)

8. *Milford Harbor, Connecticut.*—This harbor consists of a broad, open bay, from the head of which a small tidal stream extends three-quarters of a mile inland to the upper wharf. Originally the depth on the bar at the mouth of the river was less than 2 feet at mean low water; in parts of the river the channel ran nearly bare.

Under the first project for improvement, adopted in 1872, a channel 4 feet deep and 100 feet wide was excavated through the bar, and thence 40 to 60 feet wide to the upper wharf; small jetties were built to protect the east bank from erosion, and two jetties were built to preserve the channel on the bar, at a total cost of $34,000. In 1881 a project was adopted for making the channel through the bar 8 feet deep at mean low water and 100 feet wide, at an estimated cost of $11,000.

The 8-foot channel has been completed to 100 feet width.

July 1, 1893, the channel over the outer bar was in fair condition; that from the bar to the upper wharves had shoaled somewhat, especially in the upper part. Long Jetty had been repaired as far as then seemed necessary, and the project for the improvement was considered completed.

In the storm of August 24, 1893, Long Jetty suffered damage which needed prompt repair to prevent its increasing. There being no funds available for this harbor, an allotment of $250 was made from the appropriation for "examinations, surveys, and contingencies of rivers and harbors," and the repairs urgently required were made.

Upon request of parties interested in the navigation of this harbor, a plan for harbor lines was prepared and is now under consideration. The necessary surveys and maps were prepared under an allotment from "examinations, surveys, and contingencies of rivers and harbors.'

(See Appendix D 8.)

9. Housatonic River, Connecticut.—The navigable part of the river extends from Derby, Conn., to Long Island Sound, a distance of 13 miles, and was originally obstructed by several bars upon which the low-water depth was from 3 to 5 feet.

In 1871 a project was adopted for making a channel 7 feet deep at mean low water and from 150 to 200 feet wide, by dredging and rock removal and by building a dike in the river and a breakwater to protect the channel from the outer bar, at a total estimated cost of $404,961.

This project was modified in 1887, to reduce the width of channel in the river to 100 feet and to fix the length of the proposed breakwater at 5,750 feet, and the estimate for completion was revised, making it then $202,000, or from the beginning in 1871, $275,500. The annual cost of maintenance of channels was estimated at $4,000.

Up to July 1, 1893, Drews Rock had been removed, a jetty had been built at Sow and Pigs Reef, and the breakwater at the river's mouth had been made 4,740 feet long, and channels of the required depth had been several times dredged.

During the past fiscal year the channel through the outer bar has been made 75 feet wide with full 7 feet depth at low tide and the breakwater has been extended 285 feet, making its total length 5,025 feet. Work was begun upon a riprap dike, intended to straighten the channel at the bend below Stratford, near the mouth of the river, and 555 linear feet of the dike was constructed.

The total amount appropriated for improving this river since the beginning of work in 1871 is $188,500.

Future appropriations should be applied mainly to extending and enlarging the breakwater and to dredging.

July 1, 1893, balance unexpended	$16,456.19
June 30, 1894, amount expended during fiscal year	15,021.19
July 1, 1894, balance unexpended	1,435.00
Amount appropriated by act of August 17, 1894	25,000.00
Amount available for fiscal year ending June 30, 1895	26,435.00
Amount (estimated) required for completion of existing project	87,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	87,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix D 9.)

10. Bridgeport Harbor, Connecticut.—The available depth in this harbor was originally 5 feet at mean low water.

The first project for improvement provided for an 8-foot channel over the outer and inner bars. This was dredged on the outer bar in 1837, and on both bars in 1853. In 1871 a project was adopted for making a channel 12 feet deep and 100 feet wide, subsequently modified to 300 feet, and for building a jetty on the east shore to check the influx of sand.

This was accomplished in 1882, and a new project was adopted for widening to 600 feet the channel from the Inner Beacon to the Naugatuck Railroad wharf, to provide for vessels driven in by bad weather, without blocking the main channel. The estimated cost of the latter project was $60,000; it is very nearly completed. A small area remains near the Inner Beacon, which it is considered desirable to dredge. The project was extended in 1888 to include widening the channel above the railroad wharf in order to relieve the crowding at that point, and was further extended by act of Congress authorizing the expenditure of the appropriation of 1888 toward dredging a 9-foot channel up to the head of the upper harbor above the bridges, and by the river and harbor act of 1890 which directed the beginning of the breakwater from the Tongue to the Inner Beacon. The total estimated cost of these extensions was $65,000, of which $30,000 has been appropriated.

Up to July 1, 1893, a channel 12 feet deep at mean low water had been dredged to the lower bridge, with width of 200 to 300 feet, and with additional width of 470 feet between the Tongue and the Inner Beacon (total, 770 feet) for anchorage; at the outer bar and immediately below the bridge, shoaling had reduced the width of the 12-foot channel to about 75 feet. Above the lower bridge and practically to the head of navigation, the channel was 9 feet deep at mean low water with from 60 to 90 feet width. The breakwater from the Tongue to the Inner Beacon had been built its full length, 1,165 feet, but not to the full cross section considered necessary for permanence; it afforded a shelter of value to the anchorage ground and to the lower wharves.

Nothing was done during the past fiscal year.

The total amount appropriated for this harbor since the beginning of work by the United States in 1836, is $292,485.38.

The completion of the project includes extending and widening the channel above the horse-railroad bridge, removing shoals from the harbor channel, and enlarging the breakwater at an estimated cost of $35,000.

July 1, 1893, balance unexpended	$1,188.37
June 30, 1894, amount expended during fiscal year	843.97
July 1, 1894, balance unexpended	344.40
Amount appropriated by act of August 17, 1894	10,000.00
Amount available for fiscal year ending June 30, 1895	10,344.40
Amount (estimated) required for completion of existing project	25,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	25,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix D 10.)

11. *Black Rock Harbor, Connecticut.*—This harbor consists of a bay partly sheltered by Fayerweather Island, and of two small streams extending inland from the head of the bay. The depth in Cedar Creek, the more important of these streams, was from 2 to 4 feet at mean low water, and the channel was narrow and very crooked.

The project for improvement submitted in 1883 included dredging a channel 3,300 feet long, 80 feet wide, and 6 feet deep, to extend up Cedar Creek, and a breakwater from Fayerweather Island to the mainland. The estimated cost was $80,000.

Up to July 1, 1893, the breakwater had been built to the full length, but not to the width and height projected. The proposed channel had been dredged to the full extent projected, but had slightly shoaled on the sides. This channel was largely used and was indispensable to the commerce of the upper part of the harbor.

During the past fiscal year dredging was done to widen and remove shoals from the channel, which was made fully 80 feet wide and 6 feet deep at mean low water.

The breakwater is not built to the dimensions originally designed, but this does not now appear necessary and the project is considered completed.

The total amount appropriated for this harbor since the beginning of improvement in 1884 is $47,500.

No appropriation is needed for the ensuing year.

July 1, 1893, balance unexpended	$4,969.66
June 30, 1894, amount expended during fiscal year	4,664.47
July 1, 1894, balance unexpended	305.19
Amount appropriated by act of August 17, 1894	2,500.00
Amount available for fiscal year ending June 30, 1895	2,805.19

(See Appendix D 11.)

12. Saugatuck River, Connecticut.—This river is a tidal stream, extending inland about 4½ miles by course of channel from Long Island Sound to Westport, Conn. It has a natural depth of 5 feet at mean low water, in a rather narrow, crooked channel, up to the railroad bridge at Saugatuck, about 3 miles from the sound; thence the depth decreases gradually until at Westport it is less than 1 foot. The channel is somewhat obstructed by rocks in its upper part.

From 1826 to 1838 a short breakwater was built on Cedar Point, the east side of the river's mouth, to prevent sand obstructing the entrance; the work was repaired and extended in 1870. In 1836–'40 a canal was cut through "Great Marsh" to shorten the sailing course to the westward; since 1850 it has been so filled up as to be of little use.

Under the terms of the river and harbor act of 1892 a project was adopted providing for deepening the channel to the village of Westport, making it 60 feet wide and 4 feet deep at mean low water, at an estimated cost of $10,000.

July 1, 1893, the channel depths had not materially changed; the breakwater at Cedar Point needed some repair; the canal was seldom used, being passable for light-draft vessels only at high tide. Dredging had just been begun to make a channel 4 feet deep up to Westport, with width of 60 feet.

During the past fiscal year the 4-foot channel has been extended to the lower wharf on the east side of the river at Westport, making it 60 feet wide for 2,735 feet and 40 feet wide for the rest of the distance, 550 feet.

The total amount appropriated for Saugatuck River under the existing project is $10,000.

Future appropriations will be applied to widening the channel as projected.

July 1, 1893, balance unexpended	$6,029.07
June 30, 1894, amount expended during fiscal year	5,150.12
July 1, 1894, balance unexpended	878.95
Amount appropriated by act of August 17, 1894	3,000.00
Amount available for fiscal year ending June 30, 1895	3,878.95

(See Appendix D 12.)

13. Wilsons Point Harbor, Connecticut.—This harbor is a bay on the north shore of Long Island Sound, sheltered from all storms, except southerly ones. Its natural depth of 16 feet at the mouth shoaled to about 5 feet at low water at the wharves of the New England Terminal Company, a corporation formed to secure water privileges for the Housatonic Railroad system and its connections.

In 1888 $25,000 was appropriated for this improvement as a part of Norwalk Harbor, and a project was adopted for making a channel 300 feet wide and 15 feet deep up to the vicinity of the wharves. The required depth was secured with width of 400 feet.

In 1890 $30,000 was appropriated for this harbor, and up to July 1, 1893, with a total expenditure of $53,676.90, the channel up to the vicinity of the wharves had been made 15 feet deep at mean low water, and about 700 feet wide, with an additional width of 200 feet for 750 feet on the east side near the wharves.* The 15-foot channel was also extended northward, parallel to and 75 feet west of the wharves, with width of 200 feet. This permitted vessels of 15 feet draft to approach the wharves at any ordinary stage of tide.

July 1, 1893, the dredged channels were in good condition and the project was reported completed.

Nothing was done during the past fiscal year.

No further improvement at this point is needed and no further appropriation is required.

July 1, 1893, balance unexpended	$1,323.10
July 1, 1894, balance unexpended	1,323.10

(See Appendix D 13.)

14. Five Mile River Harbor, Connecticut.—This harbor is a small inlet over a mile long, and from 300 to 800 feet wide, on the north shore of Long Island Sound. The natural low-water depth at the mouth is about 3 feet, shoaling to zero half way up the harbor.

The project for improvement proposed in a report on a survey made in 1886, and adopted under an appropriation of $5,000 made August 11, 1888, provides for dredging a channel 8 feet deep at mean low water, 100 feet wide, and about 6,000 feet long, extending to the head of the harbor. The cost was estimated at $25,000.

The total amount appropriated for this improvement is $17,500.

Up to July 1, 1893, $9,971.42 had been expended, and a channel 60 feet wide and 2,450 feet long had been dredged to a depth of 8 feet at mean low water, extending from Long Island Sound to the vicinity of the lower wharves.

During the past fiscal year the channel of 8-feet depth at mean low water has been extended 1,130 feet farther up the harbor, making 60 feet width. This channel has been extended to several of the wharves by private work, and is now used for anchorage and commercial purposes.

Future appropriations will be applied to widening and extending the channel as projected.

For reasons fully stated in the report of the officer in charge, it has been found necessary to increase the estimate for completion of this project to $30,000, making the total estimated cost from the beginning $45,000.

July 1, 1893, balance unexpended	$5,028.58
June 30, 1894, amount expended during fiscal year	4,694.43
July 1, 1894, balance unexpended	334.15
Amount appropriated by act of August 17, 1894	2,500.00
Amount available for fiscal year ending June 30, 1895	2,834.15

Amount (estimated) required for completion of existing project	$27,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix D 14.)

15. *Stamford Harbor, Connecticut.*—This harbor consists of a bay on the north shore of Long Island Sound, and of two tidal inlets, known as the East and West branches, extending up to the city of Stamford. The original depth in the West Branch was from 1 to 3 feet, gradually increasing in the bay to a depth of 12 feet; the East Branch was originally a small marshy creek, deepened by private dredging to a depth of about 8 feet at mean low water.

The project of improvement adopted in 1886 provided for dredging a 5-foot channel 80 feet wide up to the head of the West Branch. This was accomplished in 1892. In that year a project was adopted providing for enlarging the channel of the West Branch to 150 feet width and 7 feet depth, and dredging out the basin between the harbor lines at the head of this branch; also for making the channel of the East Branch 100 feet wide for a length of 8,535 feet, and 50 feet wide for a length of 1,200 feet, with depth of 9 feet, at a total estimated cost of $123,500.

July 1, 1893, dredging had been recently begun upon the 9-foot channel of the East Branch.

During the past fiscal year dredging in the East Branch was continued and the channel was made 60 feet wide and 9 feet deep up to the steamboat dock, with slightly less depth and width above to the head of navigation. Several bowlders and parts of ledges were removed from the channel. A small amount of dredging was also done to remove shoals from the channel of the West Branch.

The total amount appropriated for this harbor since the beginning of improvement in 1886 is $45,000, of which $15,000 has been applied to the existing project.

Future appropriations will be applied to widening and deepening the channels as projected.

July 1, 1893, balance unexpended	$14,094.94
June 30, 1894, amount expended during fiscal year	13,368.65
July 1, 1894, balance unexpended	726.29
Amount appropriated by act of August 17, 1894	10,000.00
Amount available for fiscal year ending June 30, 1895	10,726.29
Amount (estimated) required for completion of existing project	98,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	50,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix D 15.)

16. *Harbor at Cos Cob and Mianus River, Connecticut.*—This harbor is a small inlet on the north shore of Long Island Sound, extending inland about 2 miles to the village of Mianus. The low-water channel is rather narrow, bordered by wide mud flats, and has a depth of 12 feet or over at the entrance, decreasing to 5 feet at the railroad bridge, half way up the inlet, and thence to Mianus, decreasing 2 feet.

The project for improvement, adopted in 1892, provides for dredging to make a channel 6 feet deep at mean low water, with 150 feet width to the railroad bridge, and thence to Mianus 100 feet wide, estimated to cost $36,000.

Up to July 1, 1893, the projected channel had been made over 75 feet wide up to the railroad bridge and dredging was then in progress.

During the past fiscal year the channel below the railroad bridge was widened to 150 feet.

The total amount appropriated for this improvement is $11,000.

Future appropriations will be applied to extending the dredged channel.

July 1, 1893, balance unexpended	$6,558.56
June 30, 1894, amount expended during fiscal year	6,141.03
July 1, 1894, balance unexpended	417.53
Amount appropriated by act of August 17, 1894	4,000.00
Amount available for fiscal year ending June 30, 1895	4,417.53
Amount (estimated) required for completion of existing project	25,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	20,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

(See Appendix D 16.)

17. *Port Chester Harbor, New York.*—This harbor consists of a bay opening into Long Island Sound at the mouth of Byram River and of the lower part of the river itself which is navigable for about a mile above its mouth.

The original available depth in the river was not more than a foot at low water, and Salt Rock in the river and Sunken Rock in the bay were considered dangerous obstructions.

The project for improvement, adopted in 1871, provided for the removal of these rocks to 9 and 11 feet depth, respectively, and for the construction of a breakwater at Byram Point, at the mouth of the harbor, the estimated cost being $96,632.

In 1884 the project was extended to provide for dredging a channel 2½ feet deep and from 60 to 100 feet wide from the bay to the vicinity of the village wharves.

In 1888 the project was further modified to omit the removal of Sunken Rock and to build a breakwater from that rock to Byram Point, which should also serve as a beacon on the rock. A revised estimate, made in 1890, in accordance with the modification, reduced the cost of completion by about $40,000.

Up to July 1, 1893, Salt Rock had been removed to 9 feet depth, a channel 2½ feet deep had been dredged from 60 to 100 feet wide up to within 150 feet of Port Chester bridge and 25 feet wide to the bridge, and the breakwater had been built to a length of 783 feet.

The dredging and rock removal have resulted in admitting safely vessels of greater draft than formerly. The partial completion of the breakwater has served to mark Sunken Rock and to shelter a small anchorage area at the mouth of the river.

During the past fiscal year the breakwater was extended 72 feet shoreward, and part of the work previously built was enlarged. It is now built to the full length projected, but not to the required cross section.

Future appropriations will be applied to completing the breakwater and to maintaining or enlarging the dredged channel.

July 1, 1893, balance unexpended	$4,327.24
June 30, 1894, amount expended during fiscal year	4,102.98
July 1, 1894, balance unexpended	224.26
Amount appropriated by act of August 17, 1894	5,000.00
Amount available for fiscal year ending June 30, 1895	5,224.26

Amount (estimated) required for completion of existing project	$10,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix D 17.)

18. Larchmont Harbor, New York.—This is a bay about half a mile wide and extending three-quarters of a mile inland, with depth gradually diminishing from 18 feet at and near the mouth. The mouth of the bay was obstructed by two rocks (Umbrella Rock and Huron Rock), always covered, and owing to its width the harbor anchorage was little protected from easterly and southerly storms.

A survey was ordered by Congress in 1888, and afterwards a project was adopted for connecting Umbrella Rock with the west shore and Huron Rock with the east shore by riprap breakwaters, which would sufficiently mark the rocks and would cover the harbor. The estimated cost of the project was $105,000.

Up to July 1, 1893, $4,879.05 had been expended in constructing 74 linear feet of the Umbrella breakwater and 64 linear feet of the Huron breakwater, the location being over the rocks. The breakwaters serve to mark the rocks, but are not long enough to afford any appreciable shelter.

No work has been done during the past fiscal year.

Future appropriations should be applied to completing the breakwaters.

July 1, 1893, balance unexpended	$120.95
July 1, 1894, balance unexpended	120.95

Amount (estimated) required for completion of existing project	100,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	50,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix D 18.)

19. East Chester Creek, New York.—This is a small tidal stream emptying into Pelham Bay. It was navigable at high tide only, for vessels drawing 7 feet, up to Lockwood, a distance of 2¼ miles. The rise of tide is 7.1 feet.

The project for improvement adopted in 1872 and subsequently modified provided for a channel 9 feet deep at mean high water, extending to a point 3,000 feet above Lockwood and terminating at the upper end in a tidal basin. Part of the lower course of the channel was to be protected by dikes, and the whole work was estimated to cost $221,000.

In 1891 this estimate was revised and reduced by omitting the dikes, which seemed unnecessary for maintenance of channels, making the total estimate of cost from beginning $124,000.

Up to July 1, 1893, $69,000 had been appropriated for this improvement, of which $68,984.67 had been expended in dredging and rock removal to make a channel 9 feet deep at high water (2 feet at low water), with width of 125 feet, to the head of Goose Island, one-half mile from the mouth of the creek; thence to Town Dock with width of 100 feet; thence to Lockwood with nearly the same width; thence for about 1,300 feet above the drawbridge with 60 feet width. Above Town Dock 1,235 linear feet of diking had been built to sustain the sides of the channel.

During the past fiscal year no work has been done by the United States. Private parties have cut a slip into the west bank above Lockwood and have made a landing for a newly-established freight line between Mount Vernon and New York City.

The channel between Town Dock and Lockwood has shoaled near the banks, and the present available width is not over 50 feet.

Future appropriations should be applied to completing the proposed cut above Lockwood and to repairing and maintaining the previously dredged channels. A revised estimate, submitted with the annual report for 1891, reduced the cost of completing this work to $55,000.

July 1, 1893, balance unexpended	$15.33
June 30, 1894, amount expended during fiscal year	15.33
Amount appropriated by act of August 17, 1894	12,000.00
Amount (estimated) required for completion of existing project	43,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	43,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

(See Appendix D 19.)

20. Greenport Harbor, New York.—This harbor, at the eastern end of Long Island, is exposed to easterly storms; its anchorage ground, which was sheltered by Joshua Point, has materially shoaled by the erosion of the point and by the influx of drifting sand.

The project of improvement, adopted in 1882, provided for the construction of a riprap breakwater extending from Joshua Point 1,700 feet in a southeasterly course, to arrest drifting sand, to check the erosion of the point, and to increase the sheltered area. Its cost was estimated at $46,000.

In 1890 the project was modified to provide for increasing the height of the breakwater from 3 to 5 feet above high water, instead of extending it, and to apply the rest of the estimated amount for completion to dredging and enlarging the anchorage basin.

Up to July 1, 1893, $46,000 had been appropriated for this improvement; the breakwater had been completed and dredging had been done to increase the area of sheltered anchorage ground.

During the past fiscal year the anchorage ground was further enlarged by dredging, and the existing project was completed in September, 1893.

No further work is proposed and no additional appropriation is required.

July 1, 1893, balance unexpended	$9,840.48
June 30, 1894, amount expended during fiscal year	8,544.71
July 1, 1894, balance unexpended	1,295.77

(See Appendix D 20.)

21. Port Jefferson Harbor, New York.—This harbor is a large and deep inland bay, with a narrow entrance or inlet, outside of which was originally a shoal with 4 feet depth at low water. The location of the inlet is one of the most exposed on Long Island Sound.

Under a project adopted in 1871, and modified in 1873 and 1877, an east jetty 1,390 feet long and a west jetty 940 feet long were built, both with scant cross section, and a channel 8 feet deep and 100 feet wide was dredged through the bar. The work was completed in 1883, at a total cost of $79,000.

By order of Congress an examination of Port Jefferson Inlet was made in 1888, and subsequently a project was adopted for repairing and enlarging the jetties and dredging to make a channel 10 feet deep and 200 feet wide, at an estimated cost of $90,000.

Under the existing project, up to July 1, 1893, the jetties had been enlarged, though not to the extent required, and a narrow channel of

10 feet depth had been excavated through the inlet under a contract then in progress.

During the past fiscal year the 10-foot channel through the inlet was made 200 feet wide or more, by dredging.

The total amount appropriated for improving Port Jefferson Harbor since the beginning of work in 1871 is $121,500, of which $35,000 was appropriated for work under the existing project.

Future appropriations will be applied to maintaining the dredged channel and to repairing and enlarging the jetties.

July 1, 1893, balance unexpended	$18,216.78
June 30, 1894, amount expended during fiscal year	17,017.77
July 1, 1894, balance unexpended	1,199.01
Amount appropriated by act of August 17, 1894	7,500.00
Amount available for fiscal year ending June 30, 1895	8,699.01
Amount (estimated) required for completion of existing project	47,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	35,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix D 21.)

22. *Huntington Harbor, New York.*—This is a tidal inlet, extending southward from Huntington Bay to the village of Huntington. It is about 2 miles long, quite narrow and landlocked, and has a natural available depth of nearly 8 feet at mean low water up to within three-fourths of a mile of the head of the harbor, where the low-water depth shoaled gradually to zero.

In 1872–'73 a channel 3 feet deep and 150 feet wide was dredged in the upper part of the harbor by the United States, at a cost of $22,500. Within ten years following, this had nearly filled up.

In 1884 a survey was ordered by Congress, and subsequently a project for improvement was adopted, providing for redredging a channel 8 feet deep and 100 feet wide up to the upper wharves, at an estimated cost of $42,000. The estimate includes also a pile protection for part of the channel, but it seems probable that equally good results can be obtained by applying the funds to dredging a greater width.

Up to July 1, 1893, the 8-foot channel had been dredged 105 feet wide to the bend at the steamboat landing, with width of 185 feet at the bend, and thence to the upper landings 90 feet wide.

No work was done during the past fiscal year.

The total amount appropriated for this harbor since the beginning of work in 1872 is $39,500, of which $15,000 was appropriated for work under the existing project.

Future appropriations will be applied to dredging to maintain and further widen and extend the channel.

July 1, 1893, balance unexpended	$397.49
June 30, 1894, amount expended during fiscal year	187.50
July 1, 1894, balance unexpended	209.99
Amount appropriated by act of August 17, 1894	2,000.00
Amount available for fiscal year ending June 30, 1895	2,209.99
Amount (estimated) required for completion of existing project	15,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix D 22.)

23. *Glen Cove Harbor, New York.*—This harbor is an inlet on the east

side of Hempstead Bay, which is accessible only at high tide, and a breakwater was needed to shelter vessels while at anchor waiting for tides.

The project for improvement, adopted in 1888, provides for a riprap breakwater about 2,500 feet long, extending in a west-southwesterly direction from the northwest corner of the Glen Cove dock, the top to be 5 feet wide and 3 feet above mean high water, and slopes to be 1 on 1. Its estimated cost was $201,960.

Up to July 1, 1893, 1,056 linear feet of the breakwater had been built to a reduced cross section, and nearly all of it subsequently enlarged, affording a small area of shelter which enabled vessels to use the main landing in all weather and to lie at anchor securely until the rise of tide made the inner harbor at Glen Cove navigable.

During the past fiscal year the enlargement of the breakwater to 4 feet above high water, with 3 feet top width, was completed, and the whole work was extended 20 feet, making its total length 1,076 feet.

Future appropriations will be applied to extending the breakwater as projected.

July 1, 1893, balance unexpended	$6,795.05
June 30, 1894, amount expended during fiscal year	6,562.82
July 1, 1894, balance unexpended	232.23
July 1, 1894, outstanding liabilities	16.00
July 1, 1894, balance available	216.23
Amount appropriated by act of August 17, 1894	10,000.00
Amount available for fiscal year ending June 30, 1895	10,216.23
Amount (estimated) required for completion of existing project	146,960.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	50,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

(See Appendix D 23.)

24. Flushing Bay, New York.—Before improvement the available depth in this broad, shallow bay, and in the channel leading up to Flushing, was less than 4 feet at mean low water.

The project for improvement, adopted in 1879, contemplated building 16,700 feet of diking to form a tidal basin which, by filling and discharging through the main channel, would maintain a channel depth of 6 feet or more at mean low water, after once dredging. The bottom is soft mud. The estimated cost of this work was $173,500.

In 1888 the project was modified to omit part of the diking, which then appeared unnecessary, and in 1891, at the request of many citizens, the extension of dikes was wholly omitted from the project.

Up to July 1, 1893, 4,663 linear feet of diking had been built, and the channel of 100 feet width and 6 feet depth at mean low water had been dredged and redredged.

During the past fiscal year no work was done.

The total amount appropriated for this improvement is $119,000.

The further work in Flushing Bay consists in repair and maintenance of the dredged channel. It has been found expedient to dredge to a greater depth than 6 feet in order to maintain a depth of 6 feet for more than one season.

July 1, 1893, balance unexpended	$5,019.02
June 30, 1894, amount expended during fiscal year	4,427.77
July 1, 1894, balance unexpended	591.25
Amount appropriated by act of August 17, 1894	4,000.00
Amount available for fiscal year ending June 30, 1895	4,591.25

Amount (estimated) required for completion of existing project	$54, 500.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	20, 000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix D 24.)

25. *Patchogue River, New York.*—This is a shallow tidal inlet extending about a mile northward from the shore of Great South Bay, Long Island, to the village of Patchogue. The natural depth in the stream and over a bar at the mouth was from 2 to 3 feet at mean low water, and the rise of tide is about 1 foot.

In 1880, and again in 1886, examinations were made by order of Congress, and subsequently a project was adopted for making a channel 6 feet deep at mean low water and 60 feet wide up to the village wharves, to be protected at the mouth by a jetty on the west side, at an estimated cost of $40,000.

Up to July 1, 1893, $23,000 had been appropriated for this work, and had been nearly all expended in constructing 1,340 linear feet of jetty and in dredging a channel 6 feet deep and 50 feet wide from the Great South Bay about halfway up to the village; inside the mouth of the river the channel is from 50 to 150 feet wide, being enlarged by private work mainly.

The existing channel affords access to the wharves in the lower part of the river, but should be extended to the head of the stream to make it generally useful.

During the past fiscal year nothing was done.

The channel at and outside the mouth of the river has shoaled somewhat, the banks being very soft mud.

Future appropriations will be applied mainly to dredging.

July 1, 1893, balance unexpended	$4, 180.17
June 30, 1894, amount expended during fiscal year	3, 585.97
July 1, 1894, balance unexpended	594.20
Amount appropriated by act of August 17, 1894	4, 000.00
Amount available for fiscal year ending June 30, 1895	4, 594.20

Amount (estimated) required for completion of existing project	13, 000 00
Amount that can be profitably expended in fiscal year ending June 30, 1896	13, 000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix D 25.)

26. *Browns Creek, Sayville, N. Y.*—This is a narrow stream extending northward from Great South Bay to the Sayville highway bridge, above which it is wholly a fresh-water creek. The natural depth in the creek was from 1 to 3 feet at low tide, and on a bar at the mouth it was less than 1 foot.

A survey was made by order of Congress in 1889, and a project was adopted for making the creek 100 feet wide and 4 feet deep at mean low water, the entrance channel to be protected by riprap jetties on either side, at a total estimated cost of $46,000.

The total amount appropriated for this work is $21,000.

July 1, 1893, the west jetty had been completed to a length of 492 feet, and the east jetty to 438 feet. A channel 100 feet wide and 4 feet deep at mean low water had been dredged 1,893 feet long, extending up the stream. This channel was freely used by oyster boats for refuge, and private canals cut through the adjacent meadows were used for the same purpose.

During the past fiscal year nothing was done.

Future appropriations will be applied to maintaining and extending the dredged channel and to such repairs and extensions of the jetties as become necessary.

July 1, 1893, balance unexpended	$375.83
June 30, 1894, amount expended during fiscal year	175.00
July 1, 1894, balance unexpended	200.83
Amount appropriated by act of August 17, 1894	4,000.00
Amount available for fiscal year ending June 30, 1895	4,200.83
Amount (estimated) required for completion of existing project	25,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	20,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix D 26.)

27. Removing sunken vessels or craft obstructing or endangering navigation.—1. The mast of a vessel, sunk in about 18 fathoms of water in Block Island Sound, was reported as a danger to navigation. An examination was made and no other part of the vessel was found at a depth of 30 feet below low water. At the time of examination the mast was taken out by hired labor.

It is thought that the mast was part of the schooner *Harry White*, sunk by collision in that vicinity in March, 1892.

2. The schooner *Eliza Anderson* was sunk in Long Island Sound, near Faulkners Island, in June, 1893. She was raised and towed into New Haven Harbor by a wrecking company, and, after being stripped, was abandoned where she was liable to seriously injure passing vessels. The matter was referred to the Attorney-General of the United States, and the wrecking company, upon being convinced that their action was in violation of law, again raised the wreck and sunk it in deep water in Long Island Sound.

3. The steamer *Panther*, an iron-built ocean tug, was sunk August 24, 1893, in 56 feet of water in the Atlantic Ocean, off Southampton, N. Y. Her standing mast was considered dangerous to navigation. The wreck was examined and no parts were found above 30 feet depth, except the mast and a small derrick spar, which were removed by hired labor at the time of examination, October 11, 1893.

4. The schooner *Lizzie Raymond* capsized and sunk in Long Island Sound at a point near the west end of Long Sand Shoal. The required notice to owners or interested parties was given by publication, and after advertising for proposals, a contract was entered into for the removal of the wreck by means of explosives. Under this contract all parts of the wreck which were above the level of the surrounding bottom were shattered to splinters by use of large quantities of dynamite. The removal was accomplished October 12 and 13, 1893.

The expense to the United States for the removal of these wrecks was $910.35.

(See Appendix D 27.)

IMPROVEMENT OF HUDSON RIVER AND NEW YORK HARBOR AND OF RIVERS AND HARBORS IN THEIR VICINITY, NEW YORK AND NEW JERSEY.

This district was in the charge of Lieut. Col. G. L. Gillespie, Corps of Engineers, having under his immediate orders Lieut. James G. Warren, Corps of Engineers, to December 27, 1893, and Lieut. Robert McGregor, Corps of Engineers, since that date.

1. *Hudson River, New York.*—The improvement of this river was restricted, prior to 1892, by the wording of the appropriation acts, to that part of it lying between Troy, at the head of navigation, 6 miles above Albany, and New Baltimore, about 14 miles below Albany.

Before the improvement was begun the navigable depth in the channel between New Baltimore and Albany was 7½ feet at mean low water; between Albany and Troy, 4 feet.

The mean range of tides at State Dam at Troy is 0.80 feet; at Albany, 2.32 feet; and at New Baltimore, 3.42 feet.

The plan of improvement adopted in 1867 proposed making the navigable depth between New Baltimore and Albany 11 feet, and between Albany and Troy 9 feet. This was to be accomplished by the construction of longitudinal dikes to direct the currents and by dredging.

The estimated cost of making this improvement, prepared in 1882, subject to be increased, was $1,078,304. In 1889 the estimated cost was $1,424,435.

The river and harbor act of July 13, 1892, sanctioned the new project submitted in 1891, which provided for maintaining old improvements and constructing new regulating works along 8 additional miles of the river below New Baltimore, and also for deepening the entire reach of the river under improvement so as to afford a channel 400 feet wide and 12 feet deep at mean low water from Coxsackie to the foot of Broadway, Troy, N. Y., and thence 300 feet wide and 12 feet deep to the State Dam. The estimated cost of the project is $2,500,000.

The amount expended to June 30, 1893, inclusive of outstanding liabilities, was $1,303,665.06 of which sum a large part has however, from the necessities of the case, been applied partly to the repair of decaying dikes and partly to dredging. At that date the dikes provided for in the project of improvement, so far as built, had resulted in securing a channel depth of 10 feet nearly all the way from New Baltimore to Albany and of 8 feet nearly all the way from Albany to Troy.

Under the new project, contract was entered into with P. Sanford Ross, December 19, 1892, for the removal of all the rock and sand covering rock in place; and with Edwards, Howlett, & Thompson, December 23, 1892, for all the dike work and dredging required for the improvement.

The amount expended during the fiscal year ending June 30, 1894, inclusive of outstanding liabilities, was $283,992.86, and was applied, under contract, to the construction of 10,592 feet of new dikes; to the repairs of 1,000 feet of old dikes; to dredging 544,520 cubic yards of material from the channel at Breaker Island, Stone Light, Nine Mile Tree, Mulls Cross-Over, and at New Baltimore Bar; to the removal of 13,091.6 tons of rock and 2,259.1 tons of sand covering at Austins Rock, rock in front of Watervliet Arsenal, and at Van Wies Landing; and to the removal of two wrecks from navigable channel under improvement.

July 1, 1893, balance unexpended		$674,202.60
June 30, 1894, amount expended during fiscal year		210,176.25
July 1, 1894, balance unexpended		464,026.35
July 1, 1894, outstanding liabilities	$73,816.61	
July 1, 1894, amount covered by uncompleted contracts	371,118.05	
		444,934.66
July 1, 1894, balance available		19,091.69
Amount appropriated by sundry civil act of August 18, 1894		145,000.00
Amount available for fiscal year ending June 30, 1895		164,091.69

Amount (estimated) required for completion of existing project....	$1,615,406.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	500,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

(See Appendix E 1.)

2. *Harbor at Saugerties, N. Y.*—This harbor is formed by the mouth of Esopus Creek, which empties into the Hudson River on the west bank, about 100 miles above New York City.

The bar at the entrance at the time of the original examination, made in November, 1883, with the view of preparing estimates for improvement, had a navigable depth of 3 feet only at mean low water, and the distance between the 6-foot curves across it was 1,100 feet. The harbor could, therefore, be entered only at high water even by the smallest class of vessels. The range of tides is 4 feet, approximately.

The plan of improvement which was adopted in 1887 provided for securing a depth of 8 feet, mean low water, from the entrance to the head of navigation, 1¾ miles, by the construction of two parallel dikes, each 2,300 feet long, 260 feet apart on the inside and 280 feet apart on the outside, and by dredging, if found necessary, 30,000 cubic yards of material from the channel between the dikes.

The estimated cost of the improvement was $52,000.

The amount expended upon the project up to the close of the fiscal year ending June 30, 1893,, inclusive of outstanding liabilities, was $44,338.01. At that date both dikes had been completed; the north dike had then a length of 2,058 feet and the south dike a length of 2,363 feet, and the waterway between them was 260 feet wide, and the navigable channel had been deepened by dredging for a width of 150 feet between 9-foot curves.

The amount expended during the fiscal year ending June 30, 1894, was $2,626.47, and was applied in removing, by hired labor and use of the U. S. Engineer drill scow *Hudson*, the reef at Barclays Point for a distance of 68 feet from its northern margin to a depth of 9 feet at mean low water.

The existing channel, from the entrance to the head of navigation, is 150 feet wide and 8 feet deep at mean low water.

July 1, 1893, balance unexpended	$2,817.22
June 30, 1894, amount expended during fiscal year....	2,626.47
July 1, 1894, balance unexpended....	190.75
Amount appropriated by act of August 17, 1894....	5,000.00
Amount available for fiscal year ending June 30, 1895....	5,190.75

(See Appendix E 2.)

3. *Harbor at Rondout, N. Y.*—This harbor is formed by the mouth of Rondout Creek, which empties into the Hudson River on its west side about 90 miles above the city of New York, and is the eastern terminus of the Delaware and Hudson Canal. The creek is a tidal stream for 3 miles above its mouth, and prior to 1871 all improvements had been made by private parties. The range of tides is 4 feet, approximately.

The Government made a survey of the harbor in 1869, and the available depth of water then in the channel was 7 feet at mean low water. The project of improvement, based on this survey, was for the formation and maintenance of a channel 100 feet wide and 14 feet deep, mean low water, at the mouth of the creek, to be obtained by means of dikes and dredging. The parallel channel dikes, 350 feet apart at the entrance, were to be built outward into the Hudson River, and a branch dike upstream, starting at outer end of north pier, to protect the north dike against destruction by ice.

The estimated cost of the project was $172,500.

The project was completed in 1880 at an actual cost of $90,000 only. At that time the length of the north dike was 2,200 feet, and that of the south dike 2,800 feet, and there was a channel between them 50 feet wide and 13½ feet deep, mean low water, and 100 feet wide and 12 feet deep, mean low water.

The appropriations which have been made since 1880 have been applied exclusively to the repair of the dikes.

The amount expended upon the project and upon repairs up to the close of the fiscal year ending June 30, 1893, inclusive of outstanding liabilities, was $109,428.67, at which date the navigable channel was 100 feet wide and from 12½ to 13½ feet deep, mean low water. The dikes were built originally of timber and stone to the height of mean high water, but the timber has since become so damaged by age and by the ice that the stone filling in many places has fallen out from between the rows of piles and the height of the dikes has been correspondingly lowered.

The amount expended during the fiscal year ending June 30, 1894, was $3,256.89, and was applied in repairing the north branch and south dikes, by replacing worn and decayed timber and refilling with stone.

The channel is in only fair condition, and annual repairs to the dikes will continue to be needed.

The harbor needs an appropriation of $15,000 to reconstruct 200 feet of the south dike, to dredge the harbor and channel entrance, extending from Boyce's dock to the bar, and to remove rock from channel near South Roundout Ferry.

July 1, 1893, balance unexpended	$3,256.89
June 30, 1894, amount expended during fiscal year	3,256.89
Amount appropriated by act of August 17, 1894	5,000.00
Amount (estimated) required for completion of existing project	10,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix E 3.)

4. *Wappinger Creek, New York.*—Wappinger Creek is a small stream which empties into the Hudson River on the left bank one half mile below the village of New Hamburg, N. Y. The navigable portion, extending from the mouth to Wappinger Falls, is 2 miles long, approximately, and before improvement afforded navigation to small boats drawing not exceeding 6 feet in a waterway which had a width varying from 25 feet to 75 feet. The range of tides at entrance is 4 feet, approximately.

The project for its improvement contained in the report upon the survey, November 11, 1889, to comply with the river and harbor act of August 11, 1888, contemplates a channel 80 feet wide and 8 feet deep from the mouth to the falls. The estimated cost of the improvement was $13,000. The amount appropriated by the river and harbor act of September 19, 1890, was $13,000.

The amount expended up to the close of the fiscal year ending June 30, 1893, inclusive of outstanding liabilities, was $12,837.15. At that date the channel was 80 feet wide and 8 feet deep, mean low water, from the mouth to the falls.

The balance of $162.85, remaining at the end of last fiscal year, was expended during the fiscal year ending June 30, 1894, for office expenses.

The approved project for the improvement was completed April 30, 1892.

July 1, 1893, balance unexpended	$162.85
June 30, 1894, amount expended during fiscal year	162.85

(See Appendix E 4.)

5. *Harlem River, New York.*—The Harlem River and Spuyten Duyvil Creek are both included in this improvement.

Originally there was no navigable waterway between the two streams, as the bed of the connecting reach at Kingsbridge was a long reef of solid rock, bare at low water. The head of navigation at low tide in the Harlem River was practically at High bridge, 5 miles from its junction with the East River at Hell Gate, for vessels of 7 feet draft, and, at high tide, in Spuyten Duyvil Creek, near Kingsbridge, 1¾ miles from the Hudson, for vessels of 8 feet draft.

The object of the improvement is to form a navigable channel between the East and Hudson rivers.

The project for the improvement, as originally adopted in 1875, was for a channel 350 feet wide and 15 feet deep at mean low water. In 1879 the project was so far modified as to increase the width of the channel in the Harlem River and Spuyten Duyvil Creek to 400 feet, retaining the original width of 350 feet through Dyckman Meadow, but increasing the depth there to 18 feet, mean low water. This project was revised in 1886 by narrowing the channel immediately north of High bridge, where it skirts the Ogden estate on the east bank, to a least width of 375 feet.

The estimated cost of the work was $2,700,000.

The amount expended upon the improvement up to the close of the fiscal year ending June 30, 1893, inclusive of outstanding liabilities, was $748,274.10. At that date the excavation of the section of canal prism lying between the two dams had been completed, with the exception of a ledge of rock, covering an area of about 8,000 square feet, in the northeast corner of the cut, which was in process of removal when the dams were breached during the severe storm of April 21, 1893, and which will be removed by drilling and blasting without restoring the dams. A total of 730 linear feet of stone retaining wall and 190 linear feet of timber revetment had been built to protect the side slopes of the canal chamber where necessary, to prevent the loose rock and earth arising from degradation of the slopes from falling into the cut after the canal had been opened to navigation.

In the Harlem River a channel 9 feet deep, mean low water, and about 160 feet wide had been dredged from a point 600 yards north of Morris dock, where it connects with the natural channel, to within 200 feet of the east dam. A number of large bowlders had also been removed from the channel at High Bridge and from the cross-over directly south of Morris dock, increasing the navigable depth from 7½ feet to 10 feet at the former point, and from 6½ feet to 8 feet at the latter.

In Spuyten Duyvil Creek a channel 9 feet deep, mean low water, and 140 feet to 150 feet wide had been dredged from the Hudson River Railroad drawbridge at the mouth of the creek, through the point of meadow known as Bell Pumpkin, and also through the point of meadow lying directly north of the Government dock, to within 140 feet of the west dam.

The amount expended during the fiscal year ending June 30, 1894, inclusive of outstanding liabilities, was $108,539.39. At that date the excavation of the section of canal prism lying between the two dams had been completed, with the exception of about 600 cubic yards of rock in the northeast corner of the cut, covering an area of 50 by 60 feet, with a least depth of 13 feet over it at mean low water; the remains of the dam at the west end of the cut were removed to a depth of 18 feet at low water, and the section of meadow lying directly west of the west dam was excavated to a depth of from 12 feet to 15 feet below low water to a connection with the channel dredged under former contracts through the bed of Spuyten Duyvil Creek and intervening meadows to the Hudson River, thus establishing a continuous waterway from the Hudson River to the new drawbridge now under construction across the canal at Broadway, Kingsbridge. From the rock cut westward, the improved channel was from 140 to 150 feet wide and 9 feet deep at mean low water, while the rock cut itself has a depth of 18 feet at low water, and width of about 350 feet.

In the Harlem River a channel 9 feet deep, mean low water, had been dredged from a point 600 yards north of Morris dock, where it connects with the natural channel, to within 120 feet of the temporary bridge located directly east of the east dam, and built by the city of New York for use during the construction of the above-mentioned permanent bridge at this point. There was an opening about 120 feet wide in the east dam, through which the tide flowed freely, but navigable communication between the Hudson and Harlem rivers was shut off by the temporary bridge, which is not provided with a drawspan.

The channel at the cross-over directly south of Morris dock had been deepened to a depth of 10 feet at mean low water for a width of 150 feet by the removal of bowlders and other hard material, and the waterway through the east, west, and center bays of High Bridge had been cleared of bowlders and other obstructions to a depth of 10 feet at low water so that vessels drawing 10 feet could ascend the river at low water as far as Morris dock, from which point, as already stated, 9 feet could be carried in a channel 140 to 160 feet wide to within 120 feet of the temporary bridge at Broadway.

July 1, 1893, balance unexpended		$178, 824. 08
June 30, 1894, amount expended during fiscal year		89, 581. 44
July 1, 1894, balance unexpended		89, 242. 64
July 1, 1894, outstanding liabilities	$18, 957. 95	
July 1, 1894, amount covered by uncompleted contracts	49, 035. 92	
		67, 993. 87
July 1, 1894, balance available		21, 248. 77
Amount appropriated by act of August 17, 1894		125, 000. 00
Amount available for fiscal year ending June 30, 1895		146, 248. 77
Amount (estimated) required for completion of existing project		1, 680, 000. 00
Amount that can be profitably expended in fiscal year ending June 30, 1896		500, 000. 00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.		

(See Appendix E 5.)

6. *East River and Hell Gate, New York.*—Originally the channel of East River contained many dangerous rocky obstructions to navigation, lying both above and below mean low water. Especially was this the case at Hell Gate, where the bounding beaches had irregular and

shoal rocky foreshores, and the inclosed waterway had a few detached rocky isles with crests rising several feet above high-water mark.

At Hell Gate the channel turns at right angles around Hallets Point, Astoria, and the current runs with a velocity varying at different stages of the tide from 3 to 10 miles an hour over or around Way Reef, Pot Rock, Shell Drake, Frying Pan, Hallets Point, Negro Point, Holmes Rock, Hog Back, Heel Tap, Flood Rock, Hen and Chickens, Gridiron, Mill Rocks, The Negro Heads, Rhinelander Reef, and Bread and Cheese.

Hallets Point projected from the shore at Astoria under water 325 feet to the 26-foot contour, mean low water, and embraced an area of 3 acres.

The detached rocks in the inclosed waterway had varying depths over them. The Middle Reef, with an area of about 9 acres, lay in the middle of the channels of Hell Gate. It had a small backbone, projecting above high water, called Flood Rock, upon which vessels were frequently stranded at ebb tide, when the currents swept directly over the rock. To the northward, near the mouth of the Harlem River, lay the two Mill Rocks, both of which were usually visible at high water. To the eastward, Frying Pan had only 11 feet, mean low water; Heel Tap, 12 feet; Pot Rock, 20 feet, and North Brother Island Reef, 16 feet.

The project of improvement adopted in 1867 provided for the removal to the depth of 26 feet, mean low water, of the rocks and reefs that lay directly in the channel at Hell Gate, and for the construction of sea walls and dikes upon others, that lay near the edge of the channel. The estimated cost of the project, revised in 1870, was $4,689,820.

Besides the obstructions before enumerated submerged rocks were known to exist at other points in the channel, such as Diamond Reef, 16½ feet, mean low water, off the Battery; Coenties Reef, 14.3 feet, mean low water, off Coenties Slip; Shell Reef, 9 feet, mean low water, between Eighth and Tenth streets; Ferry Reef, 7 feet, mean low water, and Charlotte Rock, 14½ feet, mean low water, opposite Thirty-fourth street; the Middle Ground, 11½ feet, mean low water, off Sunken Meadow, at the entrance to little Hell Gate, and Mid-Channel Reef, 16½ feet, mean low water, at Baretto Point opposite Rikers Island.

The project was enlarged in 1874, and the total cost estimated at $5,139,120 (Annual Report Chief of Engineers, 1874, Part II, p. 164). Besides the improvements already projected at Hell Gate, the new project provided for the construction of a riprap dike to connect the Mill Rocks, sea walls upon Hog Back and Holmes Rock, and the removal to a depth of 26 feet, mean low water, of Diamond Reef, Coenties Reef, and the small rocks known as Scaly Rock, Blackwells Rock, and the rock off Woolsey's bath house.

The project was enlarged in 1884 to provide for the removal of Pilgrim Rock, opposite Nineteenth street, to 24 feet, mean low water; in 1889 for the removal of reef off Diamond Reef to 26 feet, mean low water, and Ferry Reef and Charlotte Rock, opposite Thirty-fourth street, to 26 feet, mean low water; in 1890 for the removal of Shell Reef and reef off Sunken Meadows, to 18 feet, mean low water; and in 1892 for the removal of Baretto Reef to 24 feet, mean low water.

The amount expended up to the close of the fiscal year ending June 30, 1893, inclusive of outstanding liabilities, was $4,192,142.86. At that date Hallets Point, covering 3 acres, Way Reef, Shell Drake, Diamond Reef, North Brother Island Reef, Coenties Reef, reef off Diamond Reef, Baretto Reef, and Scaly Rock had been removed to the depth contemplated in the project. Pilgrim Rock and Ferry Reef, off Thirty-fourth street, had been reduced to a least depth of 24 feet, Heel Tap had been broken to 26 feet and dredged to 20.5 feet, and the least depths on Frying Pan and Pot Rock were 18 feet and 22.8 feet, at mean low water, respectively. Flood Rock and connecting reefs, covering 9 acres, had been broken to 30 feet, and 198,502 tons of débris had been removed. The Negro Heads and Hen and Chickens had been reduced to 18 feet, mean low water, and a new 18-foot channel, 500 feet wide, had been opened across the reef. Shelf Reef, off Ninth street, had been reduced to 18 feet, mean low water, except at a few points.

A sea wall had been built by the Government to connect Great and Little Mill rocks, and another by the city authorities on Bread and Cheese. These results have been of the greatest value to navigation.

The amount expended during the fiscal year ending June 30, 1894, was $53,147.90, and was applied in removing, by hired labor, 5,513 tons of broken stone from Flood Rock by the use of the U. S. engineer dredge *Flood Rock* and in removing 6,560 tons of broken stone by the use of U. S. steam drilling scow *Gen. John Newton*, U. S. engineer dredge *Hell Gate*, and hired dredge from reef off Sunken Meadow.

July 1, 1893, balance unexpended	$64, 555. 48
June 30, 1894, amount expended during fiscal year	53, 147. 90
July 1, 1894, balance unexpended	11, 407. 58
Amount appropriated by act of August 17, 1894	75, 000. 00
Amount available for fiscal year ending June 30, 1895	86, 407. 58
Amount (estimated) required for completion of existing project	813, 840. 67
Amount that can be profitably expended in fiscal year ending June 30, 1896	200, 000. 00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix E 6.)

7. *Newtown Creek, New York.*—This is a tidal stream, about 4 miles long, running through the eastern part of Brooklyn and emptying into the East River opposite Thirty-fourth street, New York City.

It had formerly a depth of 12½ feet, mean low water, at the mouth, gradually decreasing to 4 feet at the head.

The original project for improvement, adopted in 1880, but modified in 1883, provided for a channel 200 feet wide and 21 to 22 feet deep, mean low water, extending from the mouth up to Vernon avenue bridge, and from that point up to the head of navigation on both branches, a channel decreasing from 175 feet to 100 feet in width and from 18 feet to 10 feet in depth, at an estimated cost of $255,569.

The amount expended up to the close of the fiscal year ending June 30, 1893, inclusive of outstanding liabilities, was $177,500. At that date the channel from the entrance to Vernon avenue bridge was 175 feet wide and 18 feet deep, mean low water; from Vernon avenue bridge to Central Oil Works, 80 feet wide and 16 feet deep; from Central Oil Works to Queens County Oil Works, 100 feet wide and 14 feet deep; from Queens County Oil Works to Nichol's Chemical Works, 75 feet wide and 10 feet deep; from Nichol's Chemical Works to Maspeth avenue, 50 feet wide and 10 feet deep; from Maspeth avenue to Metropolitan avenue, east branch, 100 feet wide and 9 feet deep, and on west branch, 50 feet wide and 10 feet deep. In the English Kills Branch the channel was 100 feet wide and 8 feet deep, mean low water, from Nichol's Chemical Works to a point 700 feet to the eastward.

No work was done during the fiscal year ending June 30, 1894, as no funds were available.

The cause of the habitual shoalings immediately following dredging is the absence of bulkheads to confine the banks.

The existing channel is not adequate, in width or depth, to the demands of commerce, and the adopted project for improvement should be completed as early as practicable, by methods which will carry the improvement progressively from the mouth to the head of navigation.

Amount appropriated by act of August 17, 1894	$20,000.00
Amount (estimated) required for completion of existing project	58,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	58,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix E 7.)

8. *Buttermilk Channel, New York Harbor.*—Buttermilk Channel lies between the city of Brooklyn, N. Y., and Governors Island, New York Harbor, and was formerly obstructed by three shoals.

(1) A shoal lying above and northeast of Governors Island, projecting into Buttermilk Channel and extending over to the main channel on the other side, which originally had a least depth over it of 9½ feet at mean low water.

(2) A shoal putting out from Red Hook Point, on the Brooklyn side, and extending up the eastern side of the channel to the entrance to the Atlantic Basin, with a least depth over it of about 6 feet at mean low water.

(3) A shoal putting out from the southern side of Governors Island and extending toward Red Hook Point Shoal, which is partly dry at mean low water.

The original project of improvement, adopted in 1880, provided for the removal to a depth of 26 feet, mean low water, of such parts of the first-mentioned shoal as came within 850 feet of the Brooklyn wharves. It embraced the crest of the shoal and gave elsewhere to the north and west a depth of not less than 15 feet, mean low water.

The estimated cost of the improvement was $210,000. In view of the increasing importance of the wharves on the Brooklyn shores and the difficulty experienced by deep-draft vessels in getting up to them by reason of this shoal, the project of improvement was modified in 1885 so as to provide for the removal of the entire shoal to a depth of 26 feet, mean low water, at an estimated additional cost of $150,000, making the total estimated cost of the project $360,000.

The river and harbor act of September 19, 1890, made provision for the survey of Red Hook Shoal, lying at the southern entrance to the Buttermilk Channel, and the estimated cost of the removal of this shoal to a depth of 26 feet at mean low water was $529,000.

The amount expended to the close of the fiscal year ending June 30, 1893, inclusive of outstanding liabilities, was $334,327.99, and was applied mainly in dredging the shoal lying above Governors Island. This shoal has been entirely removed to a depth of 26 feet, mean low water.

The amount expended during the fiscal year ending June 30, 1894, was $117,416.88, and was applied in dredging 345,090 cubic yards of material from Red Hook Shoal. This shoal has been dredged to a depth of 26 feet, mean low water, for a width of 440 feet from the northern edge of the shoal marked by red buoy No. 2 southward toward the Brooklyn shore.

July 1, 1893, balance unexpended	$118,353.81
June 30, 1894, amount expended during fiscal year	117,416.88
July 1, 1894, balance unexpended	936.93
Amount appropriated by act of August 17, 1894	50,000.00
Amount available for fiscal year ending June 30, 1895	50,936.93
Amount (estimated) required for completion of existing project	354,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	200,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix E 8.)

9. Gowanus Bay, New York—Red Hook, Gowanus Creek, and Bay Ridge channels.—Gowanus Bay is a part of New York Harbor, lying at the mouth of Gowanus Creek, in the southwestern part of the city of Brooklyn.

The depth of water in the channel of Gowanus Creek and Bay was originally only from 7 to 12 feet at mean low water, which was wholly insufficient for the passage of vessels employed in the commerce of the district.

The plan of improvement adopted in 1881 provided for a depth of 18 feet to the channels in the bay leading up to the mouth of the creek on both the north and south sides, and for carrying the improvement with the same depth up the creek to Hamilton avenue bridge, a distance of 1 mile.

The channel widths were to be 200 feet, except for the last few hundred feet up to the bridge, in which distance the width would gradually decrease.

The estimated cost of this improvement was $192,564.90.

The project for 1881 was modified in 1888 by increasing the depth to 21 feet and the width to 400 feet, while to facilitate the handling of vessels in the contracted space near the mouth of Gowanus Creek more room was provided for by cutting away the angle on the south side, at an estimated total cost of $600,000.

The amount expended on the *Red Hook and Gowanus Creek channels* up to June 30, 1893, inclusive of outstanding liabilities, was $194,316.32. At that date this channel, from the entrance to Erie Basin to Twenty-eighth street, was 255 feet wide and 21 feet deep, mean low water, and thence to the foot of Twenty-third street 150 feet wide and 21 feet deep, mean low water.

The improvement of *Bay Ridge Channel*, extending from Twenty-eighth street south and west to Sixtieth street, south shore, which, under the project of 1881, was suspended in 1884, was resumed in 1891, under a specific appropriation of $100,000, contained in the river and harbor act of September 19, 1890, which provided for a channel 400 feet wide and 21 feet deep. Up to June 30, 1893, the sum of $100,772.57, inclusive of outstanding liabilities, had been expended under contract. At that date this channel was 140 feet wide and 21 feet deep, mean low water, from Twenty-eighth street south to Thirty-third street, thence 120 feet wide and 21 feet deep to Thirty-ninth street, and thence 90 feet wide and 21 feet deep to Sixtieth street, opposite Bay Ridge.

The amount expended during the fiscal year ending June 30, 1894, on the *Red Hook and Gowanus Creek channels*, inclusive of outstanding liabilities, was $56,298.01 and was applied in removing 342,270 cubic yards under contract. At that date the Red Hook Channel, from the entrance to Erie Basin to a point 2,000 feet south, was 400 feet wide and 21 feet deep, mean low water; thence to Henry street, 325 feet wide and 21 feet deep. The Gowanus Creek Channel, from Henry street to the foot of Percival street, was 215 feet wide.

The amount expended on the *Bay Ridge Channel* during the fiscal year ending June 30, 1894, inclusive of outstanding liabilities, was $76,675.97, and was applied in removing 509,867 cubic yards of material under contract. At that date this channel was 375 feet wide and 21 feet deep, mean low water, from Twenty-eighth street south to Forty-second street, and thence 300 feet wide and 21 feet deep to Sixtieth street, Bay Ridge.

The beds of both channels have been lowered from 5 to 15 feet, and as the material removed has been sand, the banks, having no confining bulkheads, have correspondingly increased their slopes, the unstable material sliding into the channels and reducing their depths.

The channels also suffer from deposits carried down from Gowanus Canal, and from deposits brought in from outlying shoals by the waves.

These sources of degradation will be appreciably exhausted only when permanent bulkheads are built along both shores to hold the soft and unstable banks.

July 1, 1893, balance unexpended		$198,795.91
June 30, 1894, amount expended during fiscal year		110,892.34
July 1, 1894, balance unexpended		87,903.57
July 1, 1894, outstanding liabilities	$22,081.64	
July 1, 1894, amount covered by uncompleted contracts	56,487.27	
		78,568.91
July 1, 1894, balance available		9,334.66
Amount appropriated by act of August 17, 1894		150,000.00
Amount available for fiscal year ending June 30, 1895		159,334.66
Amount that can be profitably expended in fiscal year ending June 30, 1896		125,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.		

(See Appendix E 9.)

10. New York Harbor, New York.—Before the improvement of the main entrance into New York Harbor was undertaken by the United States the least depth in midchannel on the bar was 23.7 feet at mean low water, and the same was the limiting depth across three other shoals between the bar and deep water in harbor.

A large proportion of the vast commerce of the port, which is carried on in vessels of great draft, could only cross these shoals at or near high water.

The project for the improvement of Gedney Channel was approved by the Secretary of War in December, 1884, and its extension to cover the whole of the main entrance to the harbor received his approval December 27, 1886. It provides for dredging a channel 1,000 feet wide and 30 feet deep at mean low water from deep water below the Narrows through the main Ship Channel and Gedney Channel to deep water outside the bar; maintaining this channel, should it be necessary, either by periodical dredging or by contracting the entrance by the construction of a dike running across the shoals from the Coney Island side, with suitable protection for the head of Sandy Hook to prevent its being scoured away by the increased current.

The estimated cost of obtaining the dredged channel was $1,490,000 for dredging 4,300,000 cubic yards, and the entire cost of the improvement, should the contraction works prove to be necessary, was estimated at between $5,000,000 and $6,000,000.

Under this project an extended survey of the lower bay was made, on which the method of improvement was based.

The total amount expended to June 30, 1893, inclusive of outstanding liabilities, was $1,579,827.37.

At that time the approved project for this work by dredging had been completed, and a depth of 30 feet, mean low water, for a channel width of 1,000 feet, had been secured from deep water below the Narrows to deep water beyond the bar.

The riprap sea wall authorized by the Chief of Engineers February 20, 1890, for the protection of the north shore of Sandy Hook, was built from Jetty No. 1 westward to a point 119 feet westward of Jetty No. 11, a total distance of 2,575 feet.

Baxter Ledge, a narrow ledge of rock lying in the entrance to Kill Van Kull from Upper New York Bay, northeast from St. George, Staten Island, and having over it originally a least depth of 18 feet, mean low water, had been removed to a depth of 25.5 feet, mean low water.

The amount expended during the fiscal year ending June 30, 1894, inclusive of outstanding liabilities, was $70,964.63, and was applied in operating the U. S. steamer *Gedney*, by hired labor, in removing 348,963 cubic yards of material from the various channels, and in strengthening the riprap sea wall built for the protection of the north shore of Sandy Hook.

July 1, 1893, balance unexpended	$88,707.77
June 30, 1894, amount expended during fiscal year	67,744.39
July 1, 1894, balance unexpended	20,963.38
July 1, 1894, outstanding liabilities	3,220.24
July 1, 1894, balance available	17,743.14
Amount appropriated by act of August 17, 1894	75,000.00
Amount available for fiscal year ending June 30, 1895	92,743.14
Amount that can be profitably expended in fiscal year ending June 30, 1896 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	150,000.00

(See Appendix E 10.)

11. Jamaica Bay, New York.—Jamaica Bay is a tidal bay, situated on the south side of Long Island, near the western end, whose waters flow into the Atlantic Ocean through Rockaway Inlet.

Inside the entrance there is a deep-water basin, from which one navigable channel leads to the northward in the direction of Canarsie, and another, called Beach Channel, to the eastward, behind Rockaway Beach, in the direction of Far Rockaway. From the eastern terminus of one of the branches of the latter channel, which passes through Conch Hole, an artificial cut into Far Rockaway Bay was made several years ago by citizens to enable small boats to pass eastward through that bay into Hempstead Bay and beyond.

The project for this improvement, contained in the report upon the survey October 29, 1891, to comply with the river and harbor act of September 19, 1890, and sanctioned by river and harbor act of July 13, 1892, contemplated a channel 60 feet wide and 5 feet deep, mean low water, from entrance to Bass Channel to foot of Bayswater avenue, Far Rockaway.

The estimated cost of the project was $9,460. The full amount of this estimate was appropriated by the river and harbor act approved July 13, 1892.

The amount expended up to the close of the fiscal year ending June 30, 1893, inclusive of outstanding liabilities, was $3,727.61. At that date 2,200 feet of the channel had been dredged to the full projected width of 60 feet and depth of 5 feet, mean low water.

The amount expended during the fiscal year ending June 30, 1894, was $8,091.85, and was applied in dredging 20,174 cubic yards of material from the channel under contract; the channel had been dredged to a width of 60 feet and a depth of 5 feet, mean low water, to within 400 feet of the bulkhead at the foot of Bayswater avenue.

July 1, 1893, balance unexpended	$8,091.85
June 30, 1894, amount expended during fiscal year	8,091.85

(See Appendix E 11.)

12. Raritan Bay, New Jersey.—Raritan Bay forms the western part of the large triangular bay inclosed between Sandy Hook, the New Jersey shore, and Staten Island.

The channel undergoing improvement lies to the southeast of Seguine Point on the south shore of Staten Island. At the time of the original survey, August, 1880, the least depth on the shoal lying between the 21-foot curve at Seguine Point and the 21-foot curve at the head of the bay was 14½ feet, mean low water. The project of improvement, based upon the survey, provided for a channel across the shoal 300 feet wide and 21 feet deep, mean low water, at an estimated cost of $126,500.

The project was enlarged in 1885, providing for a channel of equal width and depth over the shoals in the vicinity of Wards Point, Staten Island, where the original depth was 18 feet, mean low water, giving a navigable channel 21 feet deep, mean low water, up to Perth Amboy; and further providing for a channel 300 feet wide and 15 feet deep, mean low water, from Great Beds Light to South Amboy, where the original depth was 12½ feet, mean low water, at an estimated total cost of $240,500 for the two works from the beginning, which estimate was again increased in 1888 to $246,500 to provide for the removal of deposits which had taken place in the interval of three years.

The channel from deep water at the head of Raritan Bay, past Seguine Point to Perth Amboy, exceeds 5 miles in length, is crooked, and is subject to constant shoalings. As the amount appropriated any one year for the execution of the project has been much less than the estimated cost of the improvement, and as the channel excavated under each appropriation has been impaired by shoaling in a greater or less degree before work could be resumed under the succeeding appropriations, the original estimates for this improvement have little value and can not be used for determining the amount required for completing the project at this date. The cost of completing the project, if all the required money could be made available at one time, was estimated in 1891 at $175,375.

The amount expended upon the modified project of 1885, up to the close of the fiscal year ending June 30, 1893, inclusive of outstanding liabilities, was $256,405.58. At the close of the contract, June 15, 1888, the channel was 300 feet wide and 21 feet deep, mean low water, from Perth Amboy to the bend at Great Beds Light, and 300 feet wide and 20 feet deep, mean low water, across the crest of the shoal in the channel leading from the bend toward Seguine Point. At the close of the year the channel eastward of Seguine Point was 250 feet wide with a depth of 21 feet, mean low water, and the channel from Great Beds Light to South Amboy was 300 feet wide and 15 feet deep, mean low water.

The amount expended during the fiscal year ending June 30, 1894, was $19,641.33, and was applied in dredging 18,736 cubic yards of material from Seguine Point.

At the close of the fiscal year ending June 30, 1894, the channel leading eastward from Seguine Point is 250 feet wide and 21 feet deep, mean low water, and the channel from Great Beds Light to South Amboy is 300 feet wide and 15 feet deep, mean low water.

July 1, 1893, balance unexpended	$21,188.51
June 30, 1894, amount expended during fiscal year	19,641.33
July 1, 1894, balance unexpended	1,547.18
Amount appropriated by act of August 17, 1894	40,000.00
Amount available for fiscal year ending June 30, 1895	41,547.18
Amount (estimated) required for completion of existing project	55,375.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	55,375.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix E 12.)

13. *Removing sunken vessels or craft obstructing or endangering navigation.*—The steam tug *Talisman* was removed from Gedney Channel, New York Harbor, May 10, 1894, under contract with Townsend & Johnston, at a cost of $850.

A contract was entered into with John Austin March 8, 1894, for the removal of the wreck of the U. S. engineer dredge *Flood Rock*, sunk off Sunken Meadow, East River. This contract is still in force.

The barge *Milton* was wrecked on reef off Sunken Meadow, East River, and lies in 85 feet of water, with 50 feet over her deck. An attempt will be made to destroy the hull of the vessel, to prevent irregularities of the currents.

(See Appendix E 13.)

IMPROVEMENT OF RIVERS AND HARBORS IN SOUTHWESTERN PART OF LONG ISLAND AND NEAR STATEN ISLAND, NEW YORK, AND IN NORTHEASTERN NEW JERSEY.

This district was in the charge of Capt. Thos. L. Casey, Corps of Engineers; Division Engineer, Col. Henry L. Abbot, Corps of Engineers.

1. *Sumpawanus Inlet, New York.*—The channel depth at the time of the adoption of the project varied from 5 feet in the bay at mean low water to 2 feet at the wharf at the mouth of the creek, a distance of a little over half a mile.

The project for the improvement of this inlet, adopted in 1880, provides for dredging a channel 4,500 feet long and from 100 to 150 feet wide and 5 feet deep at mean low water, beginning at the 5-foot curve in the Great South Bay and extending up to the town of Babylon, Long Island, at an estimated cost of $23,115.

The amount expended under this project to June 30, 1893, was $7,000.

With this amount a channel 75 feet wide and 5 feet deep from the steamboat wharf to a point 750 feet below it was dredged, besides dredging two cuts, each 25 feet wide, alongside the wharf.

Outside of the cuts so made and extending to the 5-foot curve in the bay a shoal was left, on which the depth was only 4¾ feet.

The commerce of the inlet is reported for the calendar year 1893 to be 1,350 tons, against 1,420 tons for 1892.

There were no expenditures on account of this work during the fiscal year ending June 30, 1894, there being no funds available.

Amount (estimated) required for completion of existing project.......	$16,115.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix F 1.)

2. *Canarsie Bay, New York.*—The original condition of the channel leading to Canarsie answered to a depth of 4½ feet, mean low water.

The original project, adopted in 1879, provides for obtaining a navigable channel 6 feet deep at mean low water from Canarsie Landing to the deep water in Jamaica Bay by means of diking and the formation of a tidal basin at an estimated cost of $88,000. In the Annual Report of the Chief of Engineers, 1880, Part I, p. 574, General Newton expressed a doubt as to adequate appropriations being made for carrying out the authorized project, and suggested that dredging be tried as an expedient.

The amount expended to the close of the fiscal year ending June 30, 1893, was $48,535.88.

With this amount two pile dikes have been built and maintained, one on the north side of the outer end of the channel, the other on the south side, their lengths being 1,058 and 820 feet, respectively; the channel dredged to a depth of 6 feet, mean low water, and width of 125 feet from Canarsie Landing to deep water in Jamaica Bay. In addition to this, several other improvements, not contemplated in the main project, but which added materially to the facility of navigation, viz, the excavation of a cut 100 feet long and 50 feet wide, with a depth of 6 feet, on the east side of the steamboat landing at Canarsie, and a cut at the end of the wharf at Canarsie Landing extending through to the southwest to connect with the southwest channel, the latter for the purpose of promoting tidal circulation.

The amount expended during the fiscal year is $4,462.02. With this amount the main channel alongside and in front of Canarsie Landing was dredged to a depth of 6 feet, mean low water, and width of 70 feet for a distance of 440 feet, and the west channel was given a 4-foot mean low-water depth with widths of from 20 to 70 feet for a distance of 1,317 feet; there were also slight repairs made to the east dike.

The commerce for the calendar year 1893 is reported to be 69,510 tons, against 67,510 tons for 1892.

July 1, 1893, balance unexpended..	$4,464.12
June 30, 1894, amount expended during fiscal year..........................	4,462.02
July 1, 1894, balance unexpended	2.10
Amount appropriated by act of August 17, 1894	2,000.00
Amount available for fiscal year ending June 30, 1895....................	2,002.10

Amount (estimated) required for completion of existing project......	33,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	8,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix F 2.)

3. *Sheepshead Bay, New York.*—The original condition of the navigable channel was, for the entrance, a depth of a little over 2 feet at mean low water, and for the interior channel not less than 4 feet, except at two narrow bulkheads across said channel.

The originally adopted project (1879) was to deepen the entrance by means of converging jetties and to improve the interior channel by longitudinal dikes so placed as in some instances to form tidal reservoirs for the scour of the channel. The project was revised in 1881 and provides for excavating a channel at the outlet 100 feet wide and 6 feet deep at mean low water, to connect the bay with Dead Horse Inlet, and to dredge the interior channel; this was modified in February, 1889, the modified project contemplating a channel 5,350 feet long, 60 feet wide, and 5½ feet deep, mean low water, from the town of Sheepshead to within 1,080 feet of Dead Horse Inlet Cut, to connect with the channel of similar width and depth already existing at that point.

The amount expended on this project to the end of the fiscal year ending June 30, 1893, was $25,943.45.

With this amount a channel had been dredged 100 feet wide and 6 feet deep at mean low water, connecting the east end of the bay with Dead Horse Inlet, and the interior channel dredged 60 feet wide and 5½ feet deep at mean low water, for a distance of 3,400 feet from the town of Sheepshead toward Dead Horse Inlet. The first-mentioned channel, from a survey in 1887, was observed to have not maintained itself, having contracted to a width of 60 feet with an average depth of 5½ feet mean low water.

The expenditures during the fiscal year amount to $24.50 for office expenses.

The commerce of the bay has increased, being reported for the calendar year 1892 to be 132,000 tons, against 106,400 for 1890.

July 1, 1893, balance unexpended	$56.55
June 30, 1894, amount expended during fiscal year	24.50
July 1, 1894, balance unexpended	32.05
July 1, 1894, outstanding liabilities	29.68
July 1, 1894, balance available	2.37
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	8,200.00

(See Appendix F 3.)

4. ***Arthur Kill, New York and New Jersey.***—A history of this improvement, which originated by special resolution in the Senate, is given in the Annual Report of the Chief of Engineers, 1889, Part I, p. 819.

The improvement consists in the removal of a point of land near and to the south of the Staten Island bridge, for the purpose of straightening the channel, in order that the currents may be directed more truly in a direction perpendicular to the draw span of the bridge, thus facilitating the passage of long tows. It is estimated to cost $26,500.

A statement of condemnation proceedings for acquiring to the United States the land needed for this improvement will be found in the Annual Report of the Chief of Engineers for 1890, Part I, p. 843.

The sum of $21,090.74 had been expended up to June 30, 1893, in acquiring land and in dredging off about 1¼ acres of the point, with a resulting increase of 225 feet in the channel width and a uniform mean low-water depth of 13 feet, where the land was originally 6 feet above that plane. The total channel width at this point is now 725 feet with a minimum depth of 13 feet at mean low water.

The available balance from the appropriation of 1892 was too small to continue active operations during the fiscal year, consequently no work has been done, and the expenditures, amounting to $380, have been for office expenses.

The commerce for the calendar year 1893 is reported to be 3,384,308 tons, against 4,835,004 tons for 1892.

July 1, 1893, balance unexpended	$909.26
June 30, 1894, amount expended during fiscal year	380.00
July 1, 1894, balance unexpended	529.26
Amount appropriated by act of August 17, 1894	4,500.00
Amount available for fiscal year ending June 30, 1895	5,029.26

(See Appendix F 4.)

5. *Channel between Staten Island and New Jersey.*—Before this improvement was undertaken by the United States there was a navigable channel having a minimum depth of 9.2 feet from the deep water in Newark Bay to Elizabethport.

The first project for the improvement of the channel was made in 1873. This provided for dredging it to a depth of 16 feet for a width of 150 feet at its shallowest part and protecting the cut by parallel dikes. The estimated cost of this work was $443,210.

This project was changed in 1880 so as to dredge a channel 400 feet wide and 13 feet deep over the middle 200 feet of its width, leaving it but 12 feet deep over the remaining widths of 100 feet on each side. The estimated cost of this work was $125,705. In addition to this, it was proposed, should it be found necessary, to build four detached dikes along the line of the channel, two on the north and two on the south side, the estimated cost of which was $60,000, bringing the total estimated cost of the proposed improvement up to $185,705. Subsequently it was decided to give the channel 13 feet depth for its full width of 400 feet, increasing the estimate to $210,000.

A modification of this project, having in view the abandonment of the dikes, was submitted May 9, 1889, and was approved by Department letter dated May 15, and a further modification, calling for a uniform channel depth of 14 feet at mean low water over the entire width of 400 feet, was approved October 20, 1890.

The amount expended to June 30, 1893, was $198,243.88.

With this amount 2,237 feet of dike was built, the channel dredged throughout its entire projected length to a mean low-water depth of 13 feet, with widths varying from 300 to 350 feet, and in the vicinity of the bend at the Corner Stake Light, for a distance of 3,000 feet, the width had been increased to 400 feet, with mean low-water depths of from 13 to 14 feet.

A survey made in November, 1893, shows that the 300 to 350-foot channel between Shooters Island and the Corner Stake Light has contracted in places to a width of about 200 feet, and in the bend at the Stake Light to a width of about 140 feet.

An appropriation of $15,000 was made in the river and harbor act of July 13, 1892, and a project for its expenditure in dredging the channel to the required dimensions was approved July 26, 1892.

Work will be begun early in July, when it is expected the plant will have completed the season's work on the Raritan River.

The expenditures during the fiscal year ending June 30, 1894, amount to $1,727 for office expenses and repairs to the dredging plant in fitting out for work on this improvement.

The amount of commerce reported for the calendar year 1893 is 3,483,911 tons, against 3,642,914 tons for 1892.

July 1, 1893, balance unexpended	$15,756.12
June 30, 1894, amount expended during fiscal year	1,727.00
July 1, 1894, balance unexpended	14,029.12
July 1, 1894, outstanding liabilities	128.50
July 1, 1894, balance available	13,900.62
Amount appropriated by act of August 17, 1894	6,000.00
Amount available for fiscal year ending June 30, 1895	19,900.62
Amount (estimated) required for completion of existing project	40,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	30,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix F 5.)

6. *Passaic River, New Jersey.*—This river is being improved under two separate projects, the first applying to the river below Center street bridge, Newark, to and beyond the shoals in Newark Bay, a distance of 7⅝ miles, and the second to the upper course of the river from Center street bridge as far as Passaic, a distance of 8 miles. The most recent appropriation was, however, made in a single sum for the entire river, and the two projects will hereafter be united, so that the funds can be expended at those parts of the river most urgently needing control or repair in the interests of navigation.

a. Below Newark.—The lower portion of the river, from Center street bridge to Newark Bay, was first surveyed by the Engineer Department in 1879. The greatest depth in the channel at a point above the Elbow Beacon was only 7.1 feet, and in many places the greatest depth was 7.5 feet at mean low water.

A project was adopted, based on this survey, providing for obtaining, by diking and dredging, a channel 200 feet wide and 10 feet deep at mean low water, from the Center street bridge to Newark Bay, at a cost of $232,875.

This project was modified in 1884, pursuant to the river and harbor act of that year, providing for extending the dike at the mouth of the river into the bay, a distance of 12,000 feet, and for dredging a channel across the shoal in Newark Bay 200 feet wide and 10 feet deep at mean low water, increasing the original estimate to $353,875.

The amount expended to June 30, 1893, was $236,283.24.

With this amount 6,205 feet of dike had been built and maintained, the channel through the shoal in the bay and the channel up the river as far as Lister dock dredged to the required dimensions, and a bar above the Zinc Works dock removed to the required depth, with a width of 120 feet for a distance of 1,600 feet upstream. A survey made in December, 1892, showed that the above conditions had been fairly well maintained.

The expenditures during the fiscal year ending June 30, 1894, amount to $30,299.71. With this amount the channel between Center street and Market street bridges, Newark, was dredged to the required mean low water depth of 10 feet and width of 210 feet for a distance of 1,800 feet downstream, thence from a point 1,000 feet below Market street bridge to the Newark Steel Works, a distance of 5,000 feet, the channel was increased in width 25 to 100 feet, completing it to the full requirements of the project; a cut of the requisite depth, having a width of 30 feet and length of 1,000 feet, was made along the south side of the channel opposite Lister dock, increasing the channel width at this point to 175 to 200 feet. Extensive repairs were made to the dike in Newark Bay for its preservation and maintenance.

b. Above Newark.—Before its improvement was undertaken the upper part of the river had a navigable 6-foot channel, except at Middle, Bellville, Rutherford Park, and Holzman bars, where the depths were 4.5 feet, 3.9 feet, 3 feet, and 3.5 feet, respectively.

The project of improvement was adopted in 1872, and provided for a channel across and above the shoals from 7½ to 6 feet deep mean low water, and from 200 to 50 feet wide, to be obtained by dredging and diking at a cost of $123,924. It was modified in 1885 by extending the channel below Middle Bar 1,500 feet to the Erie Railroad bridge, increasing the estimate to $129,000, which was further increased in 1886 to $133,762. A further modification, to include the removal of Third River Bar, the redredging of bars formed by freshets, and removal of bowlders at various points in the river, increasing the estimate to $193,822, was approved October 6, 1890.

The amount expended to June 30, 1893, was $138,484.97, with which channels had been dredged to the requisite depth, with widths of from 60 to 75 feet, a channel through Third River Bar dredged to the required depth, with width of 100 feet for a distance of 800 feet, and below this bar the channel was increased in width by 40 feet with the same depth for a distance of 700 feet, and by 20 feet for a farther distance of 245 feet, giving a continuous channel through this reach having a width of 100 feet and a depth of 6 feet mean low water. In addition a channel through Belleville Bar was completed to a width of 100 feet and a mean low water depth of from 6 to 7 feet.

The expenditures during the fiscal year ending June 30, 1894, amount to $6,846.25. With this amount the channel through Rutherford Park Bar was given a mean low water depth of 6 to 8 feet and a width of 85 to 100 feet for a distance of 1,035 feet, and the channel through Holzman Bar given a similar mean low-water depth and widened 35 feet for a distance of 418 feet. The channels are now in good condition for 6-foot navigation.

The commerce of the entire river for the calendar year 1893 is reported to be 1,276,169 tons, against 1,362,647 tons for 1892.

As the river and harbor act approved July 13, 1892, makes the appropriation for the two reaches of the river under one heading, the following consolidated money statement for Passaic River is presented:

July 1, 1893, balance unexpended			$48,581.79
June 30, 1894, amount expended during fiscal year	Below Newark	$30,299.71	
	Above Newark	6,846.25	
			37,145.96
July 1, 1894, balance unexpended			11,435.83
July 1, 1894, outstanding liabilities			1,356.31
July 1, 1894, balance available			10,079.52
Amount appropriated by act of August 17, 1894			15,000.00
Amount available for fiscal year ending June 30, 1895			25,079.52
Amount (estimated) required for completion of existing project			109,347.00
Amount that can be profitably expended in fiscal year ending June 30, 1896			60,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.			

(See Appendix F 6.)

7. *Elizabeth River, New Jersey.*—This stream, which is 2⅝ miles in length from its mouth to the head of navigation, at Broad street, Eliz-

abeth, has a width of from 50 to 90 feet, and before its improvement the wharves in the city could only be reached at high water by vessels drawing less than 4 feet; its commerce was estimated at 45,000 tons annually. The range of the tide was about 4.7 feet at its mouth and 3.4 feet at Bridge street.

The project for the improvement was adopted in 1878 and provides for obtaining, by dredging, a channel 60 feet wide and 7 feet deep at high water from the mouth of the river to the head of navigation, at an estimated cost of $25,530; this was increased in 1882 to $43,160, the increase being due to advanced prices.

The amount expended under this project to June 30, 1893, was $32,353.46.

With this amount the channel had been dredged in 1883 to the required depth to within 1,000 feet of Broad street bridge, but soon became obliterated by reason of deposits of silt and sewage refuse.

It was redredged in 1891, shoals being removed from the river at the bend above South street, at South street bridge, at John street, at the bend in the river below John street, and at the New York and Long Branch Railroad bridge to a depth of 7 feet at mean high water, with widths of 30 to 50 feet, giving a 7-foot mean high-water channel with widths varying from 30 to 50 feet from the mouth of the river to within 900 feet of Bridge street bridge, in the town of Elizabeth.

A survey made in November, 1892, indicated a channel from 30 to 50 feet wide extending from the mouth to Bridge street bridge, the head of navigation, with mean high-water depths of from less than 5 feet to more than 7 feet.

The amount expended during the fiscal year ending June 30, 1894, is $2,148.01.

The work during the fiscal year consisted in dredging the channel from the bend above South street bridge to within 125 feet of Bridge street bridge, a distance of about 900 feet, to a width of 45 feet and mean high-water depth of 7 feet, removing 5,200 cubic yards of material, principally shale and gravel.

The commerce of the river for the calendar year 1893 is reported to be 28,554 tons, against 39,575 tons reported for 1892.

July 1, 1893, balance unexpended	$4, 646. 54
June 30, 1894, amount expended during fiscal year	2, 148. 01
July 1, 1894, balance unexpended	2, 498. 53
July 1, 1894, outstanding liabilities	2, 434. 66
July 1, 1894, balance available	63. 87
Amount appropriated by act of August 17, 1894	3, 000. 00
Amount available for fiscal year ending June 30, 1895	3, 063. 87
Amount (estimated) required for completion of existing project	3, 160. 00
Amount that can be profitably expended in fiscal year ending June 30, 1896	3, 160. 00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix F 7.)

8. *Rahway River, New Jersey.*—In its original condition the Rahway River had a depth of 8 feet and more at mean high water from its mouth to Bricktown, 3⅝ miles; 7 feet to Edgar dock, 4⅛ miles; 4.4 feet to Milton avenue bridge, 4¾ miles; and 4 feet to Main street bridge, 5 miles, in the town of Rahway. Its commerce was estimated at 120,000 tons, and three attempts had been made to establish a line of steamboats on the river, but had failed on account of the bad condition of the stream.

The original project for its improvement was adopted in 1878, and provides for dredging a channel 125 feet wide and 8 feet deep at high water from Bricktown to Milton avenue bridge, and 100 feet wide from than point to Main street bridge, at an estimated cost of $66,250.

The amount expended on this improvement to June 30, 1893, was $37,000.

With the above amount the channel had been given a depth of 7 feet at mean high water and width of from 100 to 50 feet to within 550 feet of the head of navigation.

There has been no appropriation for this work since 1882, and there have been no funds for expenditure since the fiscal year ending June 30, 1890. The channels have reverted nearly to their original condition.

Amount (estimated) required for completion of existing project	$29,250.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	29,250.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix F 8.)

9. *Raritan River, New Jersey.*—Before its improvement by the United States the Raritan River had a depth of 8.5 feet at "The Stakes," 3 miles; of 6.5 feet at the "Middle Grounds," 4½ miles; of 7.5 feet at Whitehead Sand dock, 8½ miles; and between this point and New Brunswick, 12¼ miles above the mouth, the channel was obstructed by a number of rocky shoals with depths of from 8.4 to 6.9 feet at mean low water. The city of New Brunswick and the Delaware and Raritan Canal, which terminates here, together with extensive brickyards on the South River, did a large commerce, estimated in 1871 at 3,053,857 tons.

The present project was adopted in 1874, and provides for obtaining by diking and dredging, and where necessary by drilling and blasting rock, a channel 200 feet wide and 10 feet deep, mean low water, from the mouth to New Brunswick, at a cost of $2,093,662.05. It was modified in 1881, pursuant to the river and harbor act of that year, by adding to it the dredging of the South Channel, about 13,000 feet long, 100 feet wide, and 5½ feet deep at mean low water, from Kearney dock to Crab Island.

The amount expended to June 30, 1893, under this project was $577,366.27.

The above amount was expended in the construction and maintenance of certain dikes required by the project at "The Stakes" and "Middle Grounds," in dredging channels 200 feet wide and 12 feet deep at mean low water at these points, and in blasting and dredging a channel of the same dimensions across the rocky shoal at Whitehead Sand dock, and thence up the river with a width of 100 feet and depth of 10 feet to within 1,880 feet of the canal lock at New Brunswick, and the channel to Acken dock redredged to a mean low-water depth of 6 feet and width of 50 feet from Raritan River to Acken wharf, a distance of 600 feet. Under two special allotments made for it in the acts of March 3, 1881, and August 2, 1882, the South Channel was dredged to the required depth for a distance of 4,000 feet. The commerce of the river is reported for the calendar year 1893 to be 1,446,658 tons, against 1,120,302 tons for 1892.

The expenditures during the fiscal year amount to $23,482.77. With this amount the channel has been given a width of 100 feet and depth of 10 feet mean low water, for a distance of 400 feet, through a river bed of extremely hard shale rock, bringing the 100-foot channel to within 1,480 feet of the canal lock at New Brunswick. Some necessary repairs to the dikes at the Middle Grounds were also made.

The amount of shale rock removed during the fiscal year is 10,876 cubic yards, at a cost of $1.93 per cubic yard.

July 1, 1893, balance unexpended	$33,883.73
June 30, 1894, amount expended during fiscal year	23,482.77
July 1, 1894, balance unexpended	10,400.96
July 1, 1894, outstanding liabilities	8,885.10
July 1, 1894, balance available	1,515.86
Amount appropriated by act of August 17, 1894	20,000.00
Amount available for fiscal year ending June 30, 1895	21,515.86
Amount (estimated) required for completion of existing project	1,462,412.05
Amount that can be profitably expended in fiscal year ending June 30, 1896	100,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

(See Appendix F 9.)

10. South River, New Jersey.—Before the improvement of this stream was undertaken by the United States, the navigation of the lower 2½ miles of its course had been abandoned, and a private canal dredged from near Washington to Sayreville on the Raritan River. In 1880, when the present project for improving the river was adopted, the mouth of the canal, on account of its faulty location, had shoaled considerably. Above Washington a depth of 2.7 feet existed to Bissetts, 3⅝ miles, and of 2.5 feet to Old Bridge, the head of navigation, 6¼ miles above the mouth of the canal at Sayreville.

The project adopted in 1880 provided for closing the river below the head of the canal, correcting the direction of the mouth of the latter, and obtaining, by diking and dredging, a depth of 8 feet mean low water, to Washington, 6 feet to Bissetts, and 4 feet to Old Bridge, straightening the channel at two points by cutting across the meadow; estimated to cost $194,695. This was modified July 30, 1892, by omitting the proposed cut-off and dikes, and substituting therefor the dredging of the river between Washington and the Raritan River Railroad bridge, reducing the original estimate to $176,975.

The amount expended under this project to June 30, 1893, was $76,038.97.

With this amount the direction of the mouth of the canal had been changed, the dikes below Washington completed and maintained, a small amount of dredging done on a shoal above Washington, a shoal at the mouth of Washington Canal removed, a channel dredged 60 feet wide through the canal and 50 feet wide across the shoal in the river below Washington, the channel between the Turnpike bridge and Raritan River Railroad bridge dredged 50 to 100 feet wide and 6 feet deep mean low water, and the channel for a distance of 350 feet above the bridge dredged to 4 feet mean low water and width of 70 feet. At Rourke Reach the channel was given a depth of 6 feet at mean low water, and width of 60 feet for a distance of 860 feet; in addition, a bar opposite Whitehead's brickyard was removed to a depth of 8 feet at mean low water, and width of 60 feet for a distance of 450 feet, and at the junction of the canal and South River a channel was excavated 350 feet long, 60 feet wide, and 6 feet deep at the same stage of the tide.

The balance of funds available being insufficient to carry on the work of improvement, no active operations were in progress during the fiscal year, and the expenditures, amounting to $1,000.77, have been for office expenses and examinations.

The present condition of the river is such that it may be navigated at any stage of the tide by vessels of 6 feet draft for a distance of about 3 miles above its mouth.

The commerce of the river was reported for the calendar year 1892 to be 162,462 tons, and for the calendar year 1893 it is given as 156,260 tons.

July 1, 1893, balance unexpended	$1,961.03
June 30, 1894, amount expended during fiscal year	1,000.77
July 1, 1894, balance unexpended	960.26
Amount appropriated by act of August 17, 1894	5,000.00
Amount available for fiscal year ending June 30, 1895	5,960.26
Amount (estimated) required for completion of existing project	93,975.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix F 10.)

11. Keyport Harbor, New Jersey.—Keyport Harbor was originally accessible at low water only to vessels drawing less than 4 feet. Before its improvement was undertaken by the United States a 6 foot channel had been dredged at private expense, which had shoaled in 1872 to 5½ feet, and in 1882 to 5 feet, the range of the tide being 4.7 feet. A large commerce was carried on, however, valued at $2,932,000.

The project for the improvement was adopted in 1873 and provided for dredging a channel 4,700 feet long, 8 feet deep at mean low water, and 200 feet wide, from the steamboat dock to the 8-foot contour in Raritan Bay, at an estimated cost of $30,475. The revised estimate of 1884 was $40,475.

The amount expended on this improvement to the close of the fiscal year ending June 30, 1893, is $35,389.32.

With the above amount a channel was dredged in 1883, from the 8-foot depth in Raritan Bay to Keyport wharf, a distance of 5,000 feet, with a width of 200 feet for the first 4,200 feet and 160 feet for the remainder. The channel did not prove permanent, having deteriorated to a width of 30 to 50 feet, and mean low-water depth of 6 to 7 feet, and was redredged in 1893 to the projected mean low-water depth, with width of from 70 to 140 feet for a distance of 400 feet in front of Keyport wharf; thence for a distance of 2,200 feet outward a cut 35 feet wide was made along the northerly side of the old channel.

No active operations have been in progress on this improvement during the fiscal year, there being no funds available, and the expenditures, amounting to $2.20, have been for office expenses.

The commerce was reported for the calendar year 1892 to be 358,391 tons.

July 1, 1893, balance unexpended	$85.68
June 30, 1894, amount expended during fiscal year	2.20
July 1, 1894, balance unexpended	83.48
Amount appropriated by act of August 17, 1894	5,000.00
Amount available for fiscal year ending June 30, 1895	5,083.48

(See Appendix F 11.)

12. Mattawan Creek, New Jersey.—Before its improvement by the United States this small stream was obstructed at its entrance into Keyport Harbor by a mud flat, on which the best depth at the worst section was 3.1 feet at mean low water, though the 3-foot channel was too narrow and tortuous for use. Above this flat a good 4-foot channel existed to 1⅛ miles above the mouth, and thence to the steamboat dock at Mattawan 3.5 feet, shoaling to 1.8 feet at the freight dock, 600 feet above and 1⅞ miles from the mouth. The range of the tide is 4.7 feet. Notwithstanding the above difficulties it carried commerce valued in 1880 at $800,000.

The project for this improvement was adopted in 1881, and provides for dredging a channel 4 feet deep at mean low water and 100 feet wide from the mouth to Winkson Creek, and thence 75 feet wide to the railroad bridge at Mattawan, 250 feet above the freight dock, at an estimated cost of $33,120.

To June 30, 1893, the amount expended under this project was $24,121.58.

With this amount channels had been dredged in 1881 and 1882 to the required depth from the mouth to the freight dock at Mattawan, with widths varying from 100 to 30 feet, and in 1891 a cut 35 feet wide was redredged to the required depth along the northerly side of the channel for a distance of 1,420 feet upstream from the mouth of the creek.

A survey made in November, 1892, showed that the channels dredged in 1881 and 1882 had almost reverted to their original condition, hence the appropriation made by river and harbor act of July 13, 1892, viz, $9,620, for completing the improvement in accordance with the approved plans will be insufficient for that purpose.

The expenditures during the fiscal year ending June 30, 1894, amount to $8,752.06. With this amount the channel between the mouth of the creek and steamboat dock at Keyport was redredged on its southerly side to a mean low-water depth of 4½ feet for a distance of 2,100 feet upstream from Keyport dock, and given a width of 50 feet for the first 1,500 feet, with 25 feet for the remainder, and on its northerly side redredged to a similar depth with a width of 25 feet for a distance of 630 feet, extending from Keyport dock upstream; from Winkson Creek to Mattawan steamboat dock the channel was redredged to a mean low-water depth of 4 to 5 feet and width of 50 feet for a distance of 4,000 feet.

The commerce for the calendar year 1893 is reported to be 578,700 tons, against 326,500 tons for 1892.

July 1, 1893, balance unexpended	$8,998.42
June 30, 1894, amount expended during fiscal year	8,752.06
July 1, 1894, balance unexpended	246.36
Amount appropriated by act of August 17, 1894	3,000.00
Amount available for fiscal year ending June 30, 1895	3,246.36
Amount that can be profitably expended in fiscal year ending June 30, 1896 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	7,000.00

(See Appendix F 12.)

13. *Shoal Harbor and Compton Creek, New Jersey.*—Shoal Harbor is an indentation of the shore on the south side of Sandy Hook Bay, 5 miles west of the entrance to Shrewsbury River. It is bare at low water and the water deepens so gradually outward that the 5-foot curve, mean low water, is only reached at a distance of 3,000 feet from the high-water line. Compton Creek, which flows into Shoal Harbor, is 5 to 6 miles long with 3 to 5 feet of water in the lower reach. At one-quarter of a mile from its mouth it is crossed by a fixed bridge, which limits navigation. Between this bridge and the harbor there is a harbor of refuge

of limited capacity, having a depth of 9 feet in places, to which fishing vessels resort when the tides allow them to cross the shoal at the entrance. The range of the tide is 4.5 feet.

The plan of improvement adopted in 1884 had in view the connection of the 5-foot mean low-water curve of the creek on the inside with the 5-foot curve of the bay by means of a dredged channel 150 feet wide, and the protection of this channel against shoaling by means of a timber dike placed on the west side of the harbor, at a total estimated cost of $64,130.

The total expenditure on this improvement to June 30, 1893, was $5,139.29, with which the channel was dredged in 1891 to a mean low-water depth of 4½ feet for a distance of 1,200 feet, beginning near the bulkhead at the mouth of the creek, with a width of 100 feet for the first 800 feet, and 70 feet for the remainder. A survey made in October 1892 showed that this channel had deteriorated to widths of from 60 to 80 feet, and mean low-water depths of from 3.2 to 4.2 feet.

No work of improvement has been done during the fiscal year ending June 30, 1894. An offer was received and accepted to dredge this channel at 54 cents per cubic yard, the work to commence upon the completion of the work on Elizabeth River, awarded to the same bidder, and on which his plant is now engaged. This work, it is expected, will be finished in the month of July.

The commerce of the creek is reported for the calendar year 1893 to be 69,500 tons, against 62,000 tons for 1892.

July 1, 1893, balance unexpended	$2, 860. 71
July 1, 1894, balance unexpended	2, 860. 71
Amount appropriated by act of August 17, 1894	3, 000. 00
Amount available for fiscal year ending June 30, 1895	5, 860. 71
Amount (estimated) required for completion of existing project	53, 130. 00
Amount that can be profitably expended in fiscal year ending June 30, 1896	8, 000. 00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix F 13.)

14. Shrewsbury River, New Jersey.—When the present project for this improvement was adopted in 1879, the river was obstructed by a number of shifting sand bars, which had caused the complete suspension of navigation in the South Branch, and only permitted the passage of vessels engaged in commerce up the North Branch at or near high water. A considerable trade was carried on, however, even under these difficult conditions.

The project originally adopted was to dredge a channel 6 feet deep at mean low water, and from 300 to 150 feet in width across the shoals from the mouth to Red Bank on the North Branch, 8 miles, and Branchport on the South Branch, 9 miles, maintaining these channels by longitudinal dikes. This project has not been modified as to the end sought, but estimates of the diking, dredging, and cost have been increased from time to time.

The amount expended on this project to June 30, 1893, was $227,646.55.

With this amount numerous dikes have been built and maintained and channels dredged and redredged in various parts of both branches and main stem, 6 feet deep and from 25 to 100 feet wide.

The expenditures as shown for the present fiscal year amount to $6,776.55. Of this amount $4,625.62 was due for work performed in the previous fiscal year and reported in Annual Report of the Chief of Engineers, 1893, Part I, p. 1130.

The work during the fiscal year consisted in opening up the navigable channels, which were partially filled with sand during the past winter, by the removal of two bars to a depth of 7 feet mean low water, one in the North Branch above Upper Rocky Point, the other in the South Branch, opposite Dike J; the former to a length of 140 feet and width of 150 feet, and the latter to a length of 280 feet and width of 75 feet. This work required the excavation of 4,200 cubic yards of material. Necessary repairs to the dike at the mouth were also made.

The commerce of the river was reported for the calendar year 1392 to be 672,000 tons. This has increased to 737,000 tons for the calendar year 1893.

July 1, 1893, balance unexpended	$6,853.45
June 30, 1894, amount expended during fiscal year	6,776.55
July 1, 1894, balance unexpended	76.90
July 1, 1894, outstanding liabilities	9.00
July 1, 1894, balance available	67.90
Amount appropriated by act of August 17, 1894	5,000.00
Amount available for fiscal year ending June 30, 1895	5,067.90
Amount (estimated) required for completion of existing project	15,062.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	15,062.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix F 14.)

15. *Manasquan* (*Squan*) *River*, *New Jersey*.—In its original condition this stream had a depth of from 4 to 6 feet at mean low water for several miles above its mouth, but was obstructed at its outlet into the ocean by a sand spit, which had deflected the stream into a channel parallel with the beach, communicating with the ocean across shifting sand bars, on which the best depth did not exceed 1½ feet at mean low water; mean range of tide 2.4 feet. In severe storms this channel was sometimes entirely closed by sand, remaining so until the fresh water in the river had accumulated sufficiently to force a new outlet. Under these conditions the river could not be used by commerce.

The project for its improvement was adopted in 1879 and contemplated dredging the lower river and obtaining, by means of jetties, a permanent outlet nearly at right angles to the beach, with a depth of 6 feet at mean low water, at an estimated cost of $52,120. This was increased to $72,000 in 1882, the increase being due to advanced prices and to a proposed increase in the length of the jetties.

The amount expended under this project to June 30, 1893, was $39,000.

With this amount two jetties had been constructed, but neither to its full length, appropriations having ceased in 1882. No permanent improvement had been effected.

An appropriation of $2,000 was made in the act of September 19, 1890, to be expended in the removal of obstructions placed by the Government at the mouth of the river, if, in the discretion of the Secretary of War, the same should be done. There were no expenditures during the fiscal year ending June 30, 1894, as the removal of the obstructions alluded to in the act of September 19, 1890, was, in the opinion of the engineer in charge, deemed unnecessary, and so reported under date of December 19, 1890, and was approved by the Secretary of War December 30, 1890.

July 1, 1893, balance unexpended	$2,000.00
July 1, 1894, balance unexpended	2,000.00
Amount (estimated) required for completion of existing project	31,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix F 15.)

16. Removing sunken vessels or craft obstructing or endangering navigation.—The wrecks of three canal boats lying in the channel of Elizabeth River, New Jersey, for the removal of which, by the United States, an allotment of $800 was authorized by the Secretary of War March 26, 1894, have been removed by the owner, George A. Morrell, of Elizabeth, N. J., at his own expense.

(See Appendix F 16.)

IMPROVEMENT OF RIVERS AND HARBORS IN SOUTHERN NEW JERSEY; OF DELAWARE RIVER AND BAY, AND OF WATERS TRIBUTARY THERETO, NEW JERSEY, PENNSYLVANIA, AND DELAWARE.

This district was in the charge of Maj. C. W. Raymond, Corps of Engineers; Division Engineer, Col. Henry L. Abbot, Corps of Engineers.

1. Delaware River, New Jersey and Pennsylvania.—Trenton, the head of natural navigation on the Delaware River, is about 30 miles above the upper part of the port of Philadelphia. In its original condition this part of the river was obstructed by shoals at the following localities: Between Bordentown and Trenton, a distance of about 5 miles, a narrow and circuitous channel existed, which carried from 3 to 6 feet at mean low water; at Kinkora Bar, about 9 miles below Trenton, a shoal carrying 7½ feet, and at Five Mile Bar, at the upper part of Philadelphia, a shoal across the Pennsylvania Channel carrying only 3 to 4 feet at mean low water, there being, however, 13 feet of water past Five Mile Bar, in the New Jersey Channel, passing south of Petty Island.

Below Philadelphia the river in its original condition presented obstructions at Mifflin Bar, which reduced the depth at mean low water to 17 feet; at Schooner Ledge and Cherry Island Flats to 18 feet; at Bulkhead Shoal and Dan Baker Shoal to about 20 feet.

In that part of the Delaware River between Trenton, N. J., and Bridesburg, Pa., efforts in the past have been directed toward relieving commerce from the obstructions which exist in the upper 9 miles of the river and deepening the channel across Kinkora Bar.

Previous to 1885 the efforts to improve the river between Philadelphia and the bay were confined to dredging, except at Schooner Ledge, where solid rock was removed under appropriations for special localities and also under general appropriations for the Delaware River below Bridesburg.

A Board of Engineers, convened by direction of the Secretary of War for the purpose of considering the subject of permanent improvement of Delaware River and Bay, recommended, under date of January 23, 1885, the formation of a ship channel from a point opposite Philadelphia, and about midway between the American Shipbuilding Company's yard and the Gas Trust wharf, to deep water in Delaware Bay, having a least width of 600 feet and a depth of 26 feet at mean low water. The formation of such a channel is to be obtained, except at Schooner Ledge, where rock would require to be removed, by regulating the tidal flow by means of dikes, with recourse to dredging, where necessary, as an aid to such contracting and regulating works. The estimated cost of obtaining a channel of the above dimensions is about $2,425,000, which covers the estimated cost of the permanent improvement of the Delaware River between the upper part of Philadelphia and deep water in the bay. This estimate of cost does not include the improvement of Philadelphia Harbor, which is a separate project. With the present requirements of commerce above Philadelphia it is not considered that the part of the river lying between Trenton and Bridesburg demands any further improvement.

The entire amount expended on the improvement of the Delaware River from 1836 to June 30, 1893, under appropriations both for special localities and the general river, was $2,163,825.73, of which $118,500 was expended on that part of the river between Trenton and the upper part of Philadelphia. As a result of this expenditure there had been formed at the latter date a channel of navigable width and 7½ feet deep at mean low water through the bars between Bridesburg and Bordentown; a channel across Kinkora Bar 7½ feet deep; a channel across Five Mile Bar 200 feet wide and from 12 to 15 feet deep; a channel from 200 to 400 feet wide and from 24 to 26 feet deep through the shoal areas at Port Richmond; a channel across Mifflin Bar 150 feet wide and from 24 to 24.4 feet deep; a channel through Schooner Ledge 330 feet wide and 24 feet deep, except over a small area recently discovered, where the depth is reduced to 23 feet at mean low water; a channel through Cherry Island Flats 200 feet wide and 26 feet deep, and a channel across Bulkhead Bar from 100 to 340 feet wide and from 24 to 26 feet deep.

The channel between Philadelphia and Camden across Smith Island Bar had been improved by the formation of a dredged cut, protected by revetment, so as to give a channel 100 feet wide with a minimum depth of 6 feet at mean low water. The revetment on the south side of this channel has been removed in the work of improving the harbor of Philadelphia, and the revetment on the north side will be removed in July, 1894.

During the fiscal year ending June 30, 1894, the sum of $50,383.16 was expended in surveys, examinations, the repair of the dike at Bulkhead Bar, under the existing contract for repair of the dike at Mifflin Bar and dredging at Cherry Island Flats, making a total expenditure since 1836 of $2,214,208.89, of which $862,208.89 has been expended on the present project.

The changes during the past fiscal year are summarized as follows:

The dredged channel across Kinkora Bar has shoaled the minimum depth at mean low water, being now about 7½ feet. At Five Mile Bar the dike has formed a channel from 13 to 15 feet deep at mean low water and 270 feet wide. At Mifflin Bar the channel has a least depth of 24.6 feet at mean low water. The 24-foot channel has now a minimum width of 100 feet. At Cherry Island Flats a channel was dredged 400 feet wide and from 25 to 27 feet deep. This channel is now shoaled to a depth of less than 24 feet over a distance of 4,000 feet, the minimum depth being 19 feet at mean low water. At Bulkhead Bar the 24-foot channel has a least width of 350 feet. The 26-foot channel has shoaled for a distance of about 1,200 feet, the minimum depth over this distance being 25.1 feet at mean low water.

July 1, 1893, balance unexpended		$138,174.27
June 30, 1894, amount expended during fiscal year		50,383.16
July 1, 1894, balance unexpended		87,791.11
July 1, 1894, outstanding liabilities	$1,101.68	
July 1, 1894, amount covered by uncompleted contracts	30,253.32	
		31,355.00
July 1, 1894, balance available		56,436.11
Amount appropriated by act of August 17, 1894		170,000.00
Amount available for fiscal year ending June 30, 1895		226,436.11
Amount (estimated) required for completion of existing project		1,305,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896		500,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.		

(See Appendix G 1.)

2. *Harbor between Philadelphia, Pa., and Camden, N. J.*—At the time of the adoption of the present project the islands in the Delaware River between Philadelphia and Camden compelled the flood and ebb currents to pursue different paths, narrowed the existing channels, and prevented the extension of wharves necessary for the purposes of commerce. The plan of improvement originally adopted by Congress provides for the removal of Smith and Windmill islands and a part of Petty Island, and the formation of a channel of ample depth and about 2,000 feet in width from Kaighn Point to Fishers Point. The project contemplates the advance of wharves and bulkheads on both the Philadelphia and Camden shores during the progress of the work. The excavation is to be done by the General Government. The advance of wharves and bulkheads is under the control of the local authorities and private owners, a portion of the material to be removed by the Government being considered available for the necessary filling. The estimated cost of the work to be done by the United States, exclusive of the cost of the islands, is $3,500,000.

The project was modified by Congress in the sundry civil act approved March 3, 1891, by authorizing a change in the line limiting the excavation on Petty Island, and by requiring that all material removed under appropriations made to that date should be deposited and spread on League Island. The latter requirement was revoked by Congress in the river and harbor act approved July 13, 1892, which provides that the material removed may be deposited in any place or places approved by the engineer officer in charge of the work.

The amount expended under the project to June 30, 1893, was $160,534.52. At that date 7,825 linear feet of revetment had been removed, 918,537 cubic yards of material, as measured in scows, had been excavated by dredging, and 614,964 cubic yards had been deposited on League Island.

During the fiscal year ending June 30, 1894, 14,839 linear feet of piling and revetment were removed from Smith, Windmill, and Petty islands, 4,924,390 cubic yards of material, as measured in scows, were dredged from Smith, Windmill, and Petty islands and the adjacent shoals, and 1,021,123 cubic yards, as measured in scows, were deposited on League Island.

Smith and Windmill islands were dredged to a plane 12 feet below mean low water, and the north side of Petty Island was dredged back so as to make the minimum width of the Pennsylvania channel at that point about 1,400 feet. Work was carried on under a contract with the American Dredging Company, dated June 1, 1893.

During the fiscal year ending June 30, 1895, it is expected that all remaining revetment will be removed, that at least 2,700,000 cubic yards, as measured in scows, will be excavated and deposited, and that at least 700,000 cubic yards, as measured in place, will be deposited and spread on League Island.

July 1, 1893, balance unexpended		$1,080,465.48
June 30, 1894, amount expended during fiscal year		750,792.84
July 1, 1894, balance unexpended		329,672.64
July 1, 1894, outstanding liabilities	$156,093.38	
July 1, 1894, amount covered by uncompleted contracts	173,579.26	
		329,672.64
Amount appropriated by sundry civil act of August 18, 1894		250,000.00
Amount (estimated) required for completion of existing project		2,009,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896		1,000,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.		

(See Appendix G 2.)

3. *Schuylkill River, Pennsylvania.*—When the work of improvement was commenced in 1870 there was a channel of entrance into the mouth of the river carrying a depth of only 10 feet at mean low water.

The original project under which work was commenced in 1870 proposed the formation of a channel 100 feet wide, with a depth of 20 feet, from the mouth of the river to Gibson Point, about 4 miles, and a depth of 18 feet from thence to Chestnut street bridge, in Philadelphia, about 3 miles.

In 1875 and 1883 this project was amended so as to increase the low-water channel between the mouth and Girard Point, a distance of about 1 mile, to 400 feet wide and 24 feet deep, and from Girard Point to Gibson Point, about 3 miles, to 250 feet wide and 20 feet deep. In 1892 the project was again modified so as to provide for the construction of dikes to maintain a navigable depth at the mouth. The estimated cost of the entire improvement is $529,959.

The amount expended upon this project to June 30, 1893, was $453,784.59, and had resulted in the formation of a channel about 150 feet wide and from 18 to 21.4 feet deep at mean low water across the bar at the river's mouth; a channel about 250 feet wide and from 20 to 24 feet deep from inside the bar to Gibson Point, except at Yankee Point, where the width is 300 feet; and from thence to Chestnut street bridge a channel of navigable width and from 17 to 20 feet deep.

During the fiscal year ending June 30, 1894, the sum of $24,100.19 was expended in repairs to the pile and earthen dikes at the mouth of the river, planting willow trees along the length of the earthen dike, and in dredging between Girard and Gibson points. All the work of dredging contemplated by the project has been completed.

The depth of the channel over the bar at the mouth has increased 2 feet, the minimum depth being 21.4 feet at mean low water. The distance across the bar is lessened 270 feet, the 24-foot curves of depth on either side of it having approached each other. It is proposed to apply available funds to dike construction and to dredging, if found necessary.

July 1, 1893, balance unexpended	$31,215.41
June 30, 1894, amount expended during fiscal year	24,100.19
July 1, 1894, balance unexpended	7,115.22
Amount appropriated by act of August 17, 1894	20,000.00
Amount available for fiscal year ending June 30, 1895	27,115.22
Amount (estimated) required for completion of existing project	24,959.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	24,959.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

(See Appendix G 3.)

4. *Ice Harbor at Marcus Hook, Pennsylvania.*—This work, in its present plan, was commenced in 1866, the object being to provide a harbor in the Delaware River to protect vessels against moving ice.

In 1785 the Commonwealth of Pennsylvania built, for the convenience of commerce, piers at Marcus Hook, extending from the shore line into the river. It is assumed that at some subsequent time these shore piers were turned over to the United States, since in 1829 an appropriation was made of $5,000 for repairing these piers, improving the harbor, and removing obstructions. No further appropriation was made until 1866.

At this latter date the project was adopted for the construction of detached piers in the harbor, consisting of stone superstructures upon crib foundations filled with stone, together with the deepening of the harbor by dredging.

In 1881 it was proposed to increase the area of the harbor by the construction of a bulkhead about 1,800 feet in length, parallel to the shore line and about 150 feet outside of high-water line, and the deepening of this added area by dredging. Nothing was done toward the carrying into effect of the modification of 1881, on account of the objections of some of the abutting property owners, and in 1881 this hitherto proposed modification was abandoned and an increased depth proposed for the areas protected by the detached piers outside of the natural shore line of the river.

The amount expended from 1866 to June 30, 1893, was $210,635.62, which was applied to the construction of two landing piers and seven detached ice piers, the deepening by dredging of the protected area, the placing of mooring piles, repairs to landing piers and mooring piles, and the necessary examinations.

During the fiscal year ending June 30, 1894, two landing piers were repaired and one group of mooring piles was replaced at a cost of $416.99.

July 1, 1893, balance unexpended	$3,364.38
June 30, 1894, amount expended during fiscal year	416.99
July 1, 1894, balance unexpended	2,947.39

(See Appendix G 4.)

5. *Ice Harbor at head of Delaware Bay, Delaware.*—The act of August 2, 1882, appropriated $25,000 for the commencement of work on the ice harbor at the head of Delaware Bay, to include the removal of some sunken piers, the remains of an old ice harbor, in the channel east of Reedy Island, Delaware.

The desirability of an ice harbor at the head of Delaware Bay has been long recognized, but until the improvement of the main ship channel shall have been materially advanced it is believed that appropriations can be applied, with better results to commerce, to the improvement of the channel rather than to the formation of an ice harbor suited to the requirements of the case. As to location, the prevailing judgment would place the ice harbor at or very near Liston Point, but since the works already planned for the improvement of the channel in this part of the river involve the construction of about 11 miles of dikes, the changes which may result from such extensive constructions render the prior location of an ice harbor hazardous.

The amount expended to June 30, 1893, was $8,763.07, of which $3,700 was applied to the removal of the sunken piers back of Reedy Island, as provided in the act of August 2, 1882, making the appropriation of $25,000. The balance was expended in surveys, examinations, preliminary studies, and office expenses.

During the fiscal year ending June 30, 1894, no expenditures were made.

July 1, 1893, balance unexpended	$16,236.93
July 1, 1894, balance unexpended	16,236.93

(See Appendix G 5.)

6. *Construction of iron pier in Delaware Bay, near Lewes, Del.*—The original project for this work proposed the construction of a landing pier about 1,700 feet in length, extending from the shore south of the breakwater into Delaware Bay to a depth of 22 feet at mean low water, the pier to consist of a substructure of wrought iron screw piles surmounted with a timber superstructure. The work was commenced in 1871, and completed, except as to superstructure, in 1880.

The amount expended to June 30, 1890, was $368,453.66, and resulted in the construction of 1,155 linear feet of pier 21 feet in width, and 546 linear feet 42 feet in width, or a total length of 1,701 feet. The depth of water at the outer end of the pier head was about 21 feet at mean low water.

During the fiscal year ending June 30, 1891, $7,033 was expended in replacing about 200 linear feet of the pier destroyed by the collisions of wrecked vessels in 1889, and in placing fender piles along 1,200 linear feet of the shore arm of the pier. The total amount expended in construction, repairs, and inspection was $378,500.

During the fiscal year ending June 30, 1894, there were no expenditures on account of this work.

The right to use this pier for railway purposes, granted in the act of July 15, 1870, has never been exercised, and, doubtless, never will be, as the pier has not sufficient strength to support the weight of modern freight engines. It is therefore impossible to obtain any assistance from the railroad company in maintaining and repairing the structure.

The timber superstructure is greatly impaired by natural decay, and is in a dangerous condition. It should be thoroughly repaired as a matter of public safety. The cost of this work will not exceed $6,300.

During the ice period of the winter of 1892-'93 the pier suffered some injuries from ice or vessels. The cluster piles at the pier head were broken and five fender piles were torn out. The repair of these injuries is estimated to cost about $650.

The need of clear regulations governing the use of this pier and the neighboring anchorage under the shelter of the Delaware Breakwater becomes very apparent during seasons of ice and storms, when the harbor is crowded with shipping. Legislation providing for the establishment of such regulations with penalties for their enforcement is recommended.

An appropriation of $860 is recommended, to provide for urgent repairs of unexpected injuries and the supervision and protection of the property and adjacent anchorage.

Amount that can be profitably expended in fiscal year ending June 30, 1896	$7,810.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix G 6.)

7. *Delaware Breakwater, Delaware.*—Under the act of Congress, May 7, 1822, $22,700 was appropriated for a survey of Delaware Bay, near Cape Henlopen, for the purpose of determining upon the site for a harbor of shelter. In 1828 an appropriation of $250,000 was made for commencing the work under a plan submitted by a board of commissioners appointed by Congress.

The project of the board contemplated the construction in the concavity of the bay, just inside Cape Henlopen, of two massive works in the *pierres perdues* or riprap system, separated by an interval or gap of 1,350 feet, the greater, called the breakwater, to afford safe anchorage during the gales from the north and east; the other, called the icebreaker, to protect shipping against northwesterly gales and the heavy drifting ice of the bay. This project was completed in 1869 under aggregate appropriations, including the first for survey, of $2,192,103.70. The stone used in the work amounted to 892,528 gross tons, and varied from one-quarter of a ton to 7 tons in weight, the smaller constituting the bulk of the mass, the larger used to cover the exterior slopes.

As completed in 1869 the breakwater is 2,558 feet long, and the icebreaker 1,359 feet long on top. The average width on top is 22 feet, and at base 160 feet. The top is from 12 to 14 feet above mean low water.

In 1882 a project was adopted for closing the gap between the breakwater and the ice breaker by means of a random stone foundation with a concrete superstructure. The random stone foundation was to be brought to a height of 12 feet below low water with a width on top of 48 feet; the concrete superstructure to have a width on bottom of 24 feet, rising to a height of 12 feet above mean low water, with a width on top of 12 feet. The estimated cost of this project was $675,000.

In 1883 and 1884 the project was modified by providing a foundation of brush mattresses for the random stone substructure and omitting the construction of a pile bridge across the gap, which formed part of the project of 1882 for closing the gap.

In 1890 the concrete superstructure was further modified by establishing its base at 15 feet below low water by making it rectangular in section, with a width of 27 feet and height of 27 feet, and by constructing the work to above the plane of high water of large concrete blocks, above which concrete in mass was to be used. The estimated cost of the modified project, including the $356,250 appropriated from 1882 to 1888, was $856,250.

In 1891 the random stone substructure having been practically completed to an average level of 15 feet below low water, the project for the hitherto proposed concrete superstructure was modified by substitution of random stone for the remaining part of the work, so as to raise the structure to a height of 14 feet above mean low water, with a width on top of 20 feet, the width at low water to be 40 feet, and the slopes below this plane to be such as may be formed by the action of the sea; between low water and the top the slopes to be about 1 on 0.7, formed by heavy stones laid in position. The estimated cost of completing this part of the work is $270,000, or, including the $486,250 appropriated from 1882 to 1892, the cost of closing the gap is $756,250.

From the beginning of the work in 1822 to June 30, 1893, the total amount expended was $2,678,191.26, of which $486,087.56 was expended on the existing project for closing the gap, the substructure having been thereby raised to the level of mean low water over the entire length of the gap, a distance of 1,350 feet.

During the fiscal year ending June 30, 1894, the sum of $109.88 was expended in office expenses.

Should funds become available it is proposed to apply them to the construction of the superstructure and the strengthening of the slopes if necessary.

The increase in the dimensions of vessels since the present harbor was designed, in 1822, and the shoaling which has ensued behind the breakwater render the harbor in its present condition inadequate to the requirements of commerce. Upon the completion of the present project of closing the gap additional anchorage area will be added to the harbor, and it is probable that the shoaling will cease and the anchorage be deepened.

Under favorable conditions the work can be completed in a single working season. Its immediate completion is urgently necessary, since the substructure in its present condition is a serious danger to navigation, being invisible at the higher stages of the tide. Two vessels have been totally wrecked upon it and several others have been severely injured. It has been found impossible to mark it in such a way as to insure the safety of coasting vessels. The appropriation of the whole amount necessary for the completion of the work is therefore recommended.

July 1, 1893, balance unexpended	$162.44
June 30, 1894, amount expended during fiscal year	109.88
July 1, 1894, balance unexpended	52.56
Amount appropriated by act of August 17, 1894	50,000.00
Amount available for fiscal year ending June 30, 1895	50,052.56
Amount (estimated) required for completion of existing project	220,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	220,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix G 7.)

8. *Rancocas River, New Jersey.*—In its original condition Rancocas River carried a minimum low-water depth of 4½ feet between the mouth and Centerton, a distance of about 7½ miles, and from Centerton to Mount Holly, a distance of about 5½ miles, a ruling depth of about 2½ feet.

The original project of 1881 proposed the formation, by a dike at Coats Bar and dredging elsewhere, of a channel from 150 to 200 feet wide and 6 feet deep at mean low water from the mouth to Centerton, and from thence to Mount Holly a channel 5 feet deep.

Operations were carried on under this project from 1881 to 1892, under appropriations aggregating $30,000, made in 1881, 1882, and 1890. To the close of the fiscal year ending June 30, 1893, $34,745.13 had been expended in the formation of a low-water channel 100 feet wide and 6 feet deep from the mouth to Centerton, 50 feet wide and 5 feet deep for a distance of about three-fourths of a mile above Centerton, and from thence to Mount Holly 25 feet wide and 4 feet deep, and in the removal of three wrecks.

During the fiscal year ending June 30, 1894, the sum of $115.19 was expended in office expenses.

July 1, 1893, balance unexpended	$154.78
June 30, 1894, amount expended during fiscal year	115.19
July 1, 1894, balance unexpended	39.59
Amount appropriated by act of August 17, 1894	3,000.00
Amount available for fiscal year ending June 30, 1895	3,039.59

Amount (estimated) required for completion of existing project	43,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	12,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

(See Appendix G 8.)

9. Alloway Creek, New Jersey.—In its original condition Alloway Creek was obstructed between its mouth and Quinton, a distance of about 10 miles, by shoal areas in the upper half of the stream, which reduced the low-water depths to from 1.3 to 4 feet.

The original project of 1889 proposed the formation, by dredging, of a channel 6 feet deep at mean low water and 60 feet wide from Quinton to a point about 1,000 feet above the Upper Hancock bridge; from thence a channel of the same depth and 75 feet wide to a locality known as the Square, where the work is to be supplemented by a dike. At a locality known as the Canal, in addition to a channel of the last-named dimensions, the width of the stream was to be increased to about 150 feet between its low-water lines.

Up to the close of the fiscal year ending June 30, 1893, $8,821 had been expended in dredging at and above the Canal, at the Square, Upper Hancock bridge, and at the shoal between the Square and Hancock bridge, whereby channels from 40 to 75 feet wide and 6 feet deep at mean low water were formed through the worst bars.

During the fiscal year ending June 30, 1894, the sum of $108.12 was expended in office expenses.

July 1, 1893, balance unexpended	$179.00
June 30, 1894, amount expended during fiscal year	108.12
July 1, 1894, balance unexpended	70.88
Amount appropriated by act of August 17, 1894	3,000.00
Amount available for fiscal year ending June 30, 1895	3,070.88

Amount (estimated) required for completion of existing project	13,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	13,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

(See Appendix G 9.)

10. Salem River, New Jersey.—In 1872 the upper part of this river was separated from the lower part by a dam and connected with the Delaware River by a canal. Thus two independent streams were formed.

In its original condition the channel of the Upper Salem River carried about 3 feet at mean low water over the bar, from 5 to 11 feet through the canal, and about 3 feet to Hoxie's bridge.

The original project for its improvement was adopted in 1881. It provided for the removal of a shoal near Biddle's Landing at an estimated cost of $4,500. The work done in 1881 and 1882 resulted in the formation of a channel 60 feet wide and from 6 to 7 feet deep at mean low water from the head of the canal to a point about 200 feet above

Biddle's Landing, leaving about 700 feet to be improved. On account of shoaling, it was then estimated that the completion of the improvement would cost from $4,000 to $6,000.

The amount expended upon this project to June 30, 1893, was $3,112.93.

No work had been in progress since 1882 until the past fiscal year, and during that year the sum of $2,349.80 was expended in the formation, by dredging, of a low-water channel 6 feet deep and 50 feet wide, from deep water at the head of the canal for a distance of 1,100 feet toward Hoxie's Landing, and in office expenses.

It is believed that the improvement will be temporary.

July 1, 1893, balance unexpended	$2,396.41
June 30, 1894, amount expended during fiscal year	2,349.80
July 1, 1894, balance unexpended	46.61
Amount appropriated by act of August 17, 1894	1,700.00
Amount available for fiscal year ending June 30, 1895	1,746.61

(See Appendix G 10.)

11. Goshen Creek, New Jersey.—In its original condition, Goshen Creek carried a low-water depth of from 2 to 4 feet, with a least low-water width of 20 feet and a high-water width of 36 feet, from Goshen to a point about 4,000 feet below; and from thence to the mouth, a distance of about 2,500 feet, a low-water depth of from 3 to 5 feet with a least width of 30 feet.

The project for its improvement, adopted in 1891, proposed the deepening and widening by dredging of the 4,000 feet of the creek below Goshen Landing to a low-water depth of 3 feet and a width of 30 feet; the formation of a dredged channel 3 feet deep and about 50 feet wide through the bar at the mouth to the limit of the sand beyond the low-water line and the protection of the channel by a sheet-pile jetty.

The improvement was commenced during the fiscal year ending June 30, 1893, and to the close of that year the sum of $2,770.16 was expended in widening and deepening the channel to the proposed dimensions over a distance of about 3,975 feet below Goshen Landing. By this work about one-fourth of the projected improvement has been completed and the navigable conditions have been proportionately improved.

The sum of $206.70 was expended during the past fiscal year for office expenses.

July 1, 1893, balance unexpended	$229.84
June 30, 1894, amount expended during fiscal year	206.70
July 1, 1894, balance unexpended	23.14
Amount appropriated by act of August 17, 1894	3,000.00
Amount available for fiscal year ending June 30, 1895	3,023.14
Amount (estimated) required for completion of existing project	6,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	6,000.00

Submitted in compliance with requirements of sectons 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

(See Appendix G 11.)

12. Removing sunken vessels or craft obstructing or endangering navigation.—During the past fiscal year the following wrecks were removed under the provisions of the act of July 14, 1880. The schooner *Booth Brothers*, from Brigantine Shoal, New Jersey; the canal boat *General Grant*, from the channel of the Delaware River off the foot Bridge street, Bridesburg, Pa.; a portion of an unknown vessel, from the channel opposite Barnegat Light, New Jersey; the schooner *Kent*, from the bar above the head of Smith Island, Delaware River; the steamer *Maryland*, from the channel of Schuylkill River, below Point Breeze; and the canal boat *Enterprise*, from the channel in Delaware River at the entrance to Salem River, New Jersey. The cost of the work of removing these vessels was $3,262.93.

(See Appendix G 12.)

IMPROVEMENT OF RIVERS AND HARBORS IN DELAWARE, AND IN MARYLAND AND VIRGINIA, EAST OF CHESAPEAKE BAY.

This district was in the charge of William F. Smith, United States agent, major of engineers, U. S. Army, retired; Division Engineer, Col. William P. Craighill, Corps of Engineers.

1. *Wilmington Harbor, Delaware.*—Previous to 1836, when the first appropriation for the improvement of Christiana River was made, the depth of water at the entrance was about 8½ feet. The minimum depth in the channel of the portion of the river below Third street bridge was 8 feet. This depth was increased, by dredging, in that year to 10 feet. Under a project commenced in 1871 and completed in 1881 a 12-foot channel from 100 to 200 feet wide was made from the mouth to above the city of Wilmington. The present project was adopted in 1881, and is for a 15-foot low-water channel from the mouth of the river to the Pulp Works, with a width of 150 feet from the mouth to the Rolling Mill wharf, 100 feet to the Delaware and Western Railroad bridge, and 75 feet to the Pulp Works. The project included further a channel 12 feet deep and 50 feet wide, from the latter works to the Delaware Railroad bridge, and construction of a jetty on the north side of the mouth of the river. Dredging operations and the construction of the jetty were begun in the following year. The original estimate was $175,551, which was increased in 1883 to $191,384 by changing the width of the proposed channel to 150 feet throughout. In 1884 the project was amended by raising the height of the jetty 4 feet. An extension of 322 feet to the jetty, as then built, was also proposed and approved, but has not yet been carried out.

Up to the close of the fiscal year ending June 30, 1893, the sum of $215,840.21 had been expended under this project. There was then an improved channel 15 feet deep at mean low water and 150 feet wide from the 15-foot depth outside the bar at the mouth to a point 75 feet east of Market street bridge, except over the rock below Third street bridge, the removal of which to 15 feet was then in progress.

During the past fiscal year the contract, dated November 19, 1892, for dredging and removal of rock, was completed, and the channel extended in an up-river direction 4,370 feet. Of this distance the lower 2,590 feet have been dredged to the approved width of 150 feet; within the following 820 feet the channel was made 80 feet wide, and the remaining distance of 960 feet 40 feet wide, terminating at the Pulp Works, the upper limit of the proposed improvements. The depth made is 15 feet at mean low water. The ledge of rock in mid-river below Third street bridge, was removed by blasting to the same depth. The total amount of material removed during the fiscal year was 85,411 cubic yards sand, gravel, mud, and clay, in equal proportions, and 217 cubic yards of rock. Vessels drawing from 12 to 15 feet of water can now reach the Walton & Whann Chemical Works and the Pulp Works at any stage of the tide, which heretofore they could do only at high water.

There remains to complete the present project the widening of the channel dredged the past fiscal year to the approved width of 150 feet, and the extension of the jetty.

July 1, 1893, balance unexpended	$27, 909. 79
June 30, 1894, amount expended during fiscal year	24, 716. 54
July 1, 1894, balance unexpended	3, 193. 25
Amount appropriated by act of August 17, 1894	25, 000. 00
Amount available for fiscal year ending June 30, 1895	28, 193. 25
Amount (estimated) required for completion of existing project	22, 634. 00
Amount that can be profitably expended in fiscal year ending June 30, 1896	22, 634. 00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix H 1.)

2. *Ice harbor at New Castle, Del.*—This harbor is one of the oldest on the Delaware River constructed for the protection of vessels against floating ice, its origin dating back to Colonial times. For many years it was the northern terminus of the New Castle and Frenchtown Railroad, one of the oldest in the country, from which transfers were made upon boats sailing to and from Philadelphia and farther north. Since the beginning of the present century its improvement and enlargement has been carried on by the United States Government at different periods, and up to the close of the fiscal year ending June 30, 1893, $235,200.94 had been expended.

The present project, which was adopted in 1884, provided for the repair of Pier M, the placing of riprap around it and Pier N, and the rebuilding of Pier H; also the increase of the area and depth of the harbor by dredging, the amount appropriated therefor being $22,600. The project, so far as relates to the ice piers, was completed in 1891.

During the past fiscal year the available balance of the appropriation of September 19, 1890, was expended in dredging the shoaler portion of the harbor to a depth of 18 feet below mean low water from the 18-foot contour to within 10 feet of the wharf line. The harbor space for deep-draft vessels was thus materially increased. This completes the project.

The harbor in its present condition affords the best shelter in winter to vessels proceeding up or down the Delaware when the ice is running. It has, however, on many occasions proved inadequate to protect all those that sought refuge in exceptionally severe weather, and, in consequence, those moored near the outer ice piers were much exposed. An additional ice pier farther out in the river would give better protection, and as the ice piers, especially the older ones, are liable to be damaged by ice or by collision with vessels and may need immediate repairs, a small sum should be available to keep them in proper condition.

July 1, 1893, balance unexpended	$3, 583. 00
June 30, 1894, amount expended during fiscal year	3, 454. 35
July 1, 1894, balance unexpended	128. 65

(See Appendix H 2.)

3. *Appoquinimink River, Delaware.*—This stream is a tidal tributary of Delaware Bay, flowing through Newcastle County, Del. It is navigable for about 10 miles for vessels of light draft. A bar, having only 1½ feet of water over it at low tide, obstructs the mouth of the river seriously during that stage of the tide. The average rise and

fall of the tide is 6 feet at the mouth and 3.2 feet at Odessa, the head of navigation.

The project for improvement proposed in a report on a survey of the river made in 1889 and adopted under an appropriation made by the river and harbor act approved September 19, 1890, provides for dredging a channel 8 feet deep at mean low water with a width of 100 feet from the mouth to New bridge, near Townsend's wharf, and thence 80 feet wide to the county bridge at Odessa, a total distance of 5 miles, the estimated cost of the improvement being $39,963. At the close of the fiscal year ending June 30, 1893, the sum of $10,000 had been expended and the river had been dredged, in a down-river direction, from Watkins wharf to a point 6,762 feet below Odessa bridge, resulting in a greatly increased harbor space at the town of Odessa and a marked improvement of the channel, which gave great relief to shipping. The actual distance dredged is 6,462 feet, of which 2,570 feet is 80 feet wide and 3,892 is 50 feet wide

There were no operations during the fiscal year 1894, the appropriation having been exhausted the previous year.

Amount appropriated by act of August 17, 1894	$5,000.00
Amount (estimated) required for completion of existing project	24,963.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix H 3.)

4. *Smyrna River, Delaware.*—This river, formerly called Duck Creek, had, before improvements began in 1879, a minimum depth of 2½ feet within the river and about 4 feet over the bar at the mouth. Navigation was possible only at high tide, and was carried on by one steamer and seven small schooners.

In 1878 a project was made for the improvement of the whole river, including a plan for deepening the channel across the bar at the mouth. By special direction of Congress the improvement of the bar was commenced first, and during the following four years three appropriations, aggregating $10,000, were expended in dredging a channel across this obstruction 100 feet wide and 8 feet deep at mean low water. The dredged channel soon filled up again.

A new project was submitted in 1887 for a 7-foot low-water channel 60 feet wide inside the river and 100 feet at the bar, the channel at the latter point to be protected on each side by stone jetties. The estimated cost of this project is $90,698.40 The portion of the project relating to dredging has been adopted, the estimated cost thereof being $37,365.20

Up to the close of the fiscal year ending June 30, 1893, the sum of $14,950.82, had been expended in dredging inside the river and a channel had been dredged 40 feet wide and 6½ feet deep at mean low water between Smyrna Landing, the head of navigation, and Eagle Nest Landing, about 5 miles below.

The channel made has been of great benefit to navigation and has facilitated expeditious and regular transportation which before was impossible.

During the past fiscal year the dredged channel was widened and deepened to the full approved dimensions at six different localities that needed the enlargement most, five within the upper and one within the middle section of the river, and upon request of the Smyrna Steamboat Company a cut was dredged to a width of 50 feet and a depth of 7 feet across a narrow shoal situated one-half of a mile above the mouth of the river; 19,593 cubic yards of material was removed during these operations.

About 4 miles of the channel now 40 feet wide and 6½ feet deep remain to be enlarged to the dimensions called for by the project.

Several large factories have been built near Smyrna Landing and the erection of others is in contemplation, and it is reported that these improvements are due to the increased shipping facilities afforded by the improved channel.

July 1, 1893, balance unexpended	$3,049.18
June 30, 1894, amount expended during fiscal year	2,855.09
July 1, 1894, balance unexpended	194.09
Amount appropriated by act of August 17, 1894	5,000.00
Amount available for fiscal year ending June 30, 1895	5,194.09
Amount (estimated) required for completion of existing project	14,365.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893	

(See Appendix H 4.)

5. *Murderkill River, Delaware.*—This river is a tidal stream and a tributary of Delaware Bay, and flows through Kent County, Del. Its navigable portion is about 9 miles long. The condition of the river is fair for the greater part of its length, the average width and depth being 90 and 6 feet, respectively. Outside the junction with Delaware Bay, however, exists a serious obstruction, the flats, which are nearly bare at low tide and extend for nearly a mile from the shore. The average rise and fall of the tide at the mouth is 3.83 feet.

The project for improvement proposed in a report on a survey made in 1891 provides for a channel 7 feet in depth at mean low water, 80 feet in width from Frederica, at the head of navigation, to the mouth of the river, and 150 feet in width across the flats at the mouth to the 7-foot depth in Delaware Bay, the cut at the mouth to be protected by forming an embankment of the dredged material on each side, the estimated cost being $47,550.

The first appropriation for this improvement, being $7,000, was made by the river and harbor act of July 13, 1892, and at the close of the fiscal year ending June 30, 1893, dredging at the mouth of the river was in progress, $152.90 having been expended, and a cut 220 feet long, 60 feet wide, and 5 feet deep at mean low water had been dredged at the shore end of the proposed channel across the flats.

Operations were continued during the first two months of the fiscal year, and were completed on August 31, the 5-foot channel 60 feet in width having been dredged across the flats to the corresponding depth in Delaware Bay, a distance of 4,840 feet.

Immediately after the cut had been completed a steamboat line was established between the town of Frederica and Philadelphia, the boat making semiweekly trips.

July 1, 1893, balance unexpended	$6,847.10
June 30, 1894, amount expended during fiscal year	6,823.32
July 1, 1894, balance unexpended	23.78
Amount appropriated by act of August 17, 1894	[*] 6,500.00
Amount available for fiscal year ending June 30, 1895	6,523.78

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[*] Of this amount $1,500 may be used in removing shoal at mouth of St. Jones River.

Amount (estimated) required for completion of existing project	$35,550.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix H 5.)

6. *Mispillion River, Delaware.*—This river is a tributary of Delaware Bay and enters the latter about 17 miles northwest of Cape Henlopen. It is navigable for about 12 miles, as far as Milford, a thriving town with shipyards and numerous factories. The mouth of the river is greatly obstructed by a flat foreshore without a channel. Vessels can only enter and depart at high water, which rises on an average 4 feet.

The river from Milford to the mouth was improved by the General Government between the years 1879 and 1889, and $17,000 expended in making a channel 40 feet wide and 6 feet deep at mean low water.

The project for improvements at the mouth of the river, proposed in a report on a survey made in 1891, provides for a cut across the flats in a southeasterly direction, having a width of 150 feet and a depth of 6 feet at mean low water, beginning opposite the light-house and ending in deep water in the bay; the cut to be protected on the upper or north side by a bank made of excavated material. The estimated cost is $24,000.

An appropriation of $12,000 for this work was made by the river and harbor act approved July 13, 1892.

Up to the close of the fiscal year ending June 30, 1893, $1,089.38 was expended on the project. A contract had been made for dredging about 80 feet in width of the proposed cut, and work thereon had been begun in May, 1893; but owing to the strong currents inside the mouth of the river and the live condition of the dredged material the contractor had been unable to maintain a proper depth in the cut made until some protective works could be built. Dredging was therefore suspended in June, 1893, 6,829 cubic yards of material having been dredged. It was then concluded to build a pile dike on the side exposed to the waves and cross currents, to protect the inner end of the cut, which could not be kept open by the dredge. This having been approved and an allotment made from the available appropriation, 500¾ feet of dike were built during September and October, 1893, along the north edge of the proposed cut, beginning at high-water mark on Sandy Point. Dredging operations were then resumed on October 20, and were completed on November 30, a cut 570 feet long, 80 feet wide, and 5 feet deep at mean low water having been made in a southeasterly direction into the flats from deep water inside the mouth of the river. Additional cuts were made along the dike, the excavated material being used to form mud revetments on both sides of the same.

On account of the great distance across the obstructing mud flats the proposed improvements can not even be partially made available for navigation until they are nearly or entirely completed.

July 1, 1893, balance unexpended	$10,910.62
June 30, 1894, amount expended during fiscal year	9,416.71
July 1, 1894, balance unexpended	1,493.91
Amount appropriated by act of August 17, 1894	10,000.00
Amount available for fiscal year ending June 30, 1895	11,493.91

Amount (estimated) required for completion of existing project	2,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	2,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix H 6.)

7. *Broadkiln River, Delaware.*—In its original condition the depth of water in the river was from 3 to 4 feet at the numerous shoals which impeded navigation. The depth at the entrance was and still is from 1½ to 2 feet at low water.

The original project for improvement was made in 1871, and is for a 6-foot low-water navigation, with a minimum width of 40 feet from the mouth of the river to Milton, the head of navigation, and for a new entrance, protected by a jetty, at an estimated cost of $80,447. This project was modified in 1881 relative to the entrance, and the estimate reduced to $51,450. The channel within the river has been completed in accordance with the project at an expense of $35,000, which was the total amount expended at the close of the fiscal year ending June 30, 1893. After entering, vessels are no longer detained by the shoals at low tide and proceed directly to their destination.

The amount required for the completion of the project is for the improvements at the mouth of the river as designed in 1871 and modified in 1881. In view, however, of the projected location (only a few miles below the Broadkiln River) of the outlet for the inland waterway from Chincoteague Bay to Delaware Bay, a question has arisen whether the Broadkiln River can not be connected with the waterway at much less cost and with greater advantage to both. It is therefore not considered advisable to continue work on the project at present.

Amount (estimated) required for completion of existing project........ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	$21,500.00

(See Appendix H 7.)

8. *Inland Waterway from Chincoteague Bay, Virginia, to Delaware Bay, at or near Lewes, Del.*—This improvement is made with a view to forming an inland navigation route about 75 miles in length, beginning in Chincoteague Bay and following generally deep water in Synepuxent, Isle of Wight, and Big and Little Assawaman bays; thence across the country for about 4 miles from Little Assawaman Bay to Indian River Bay; thence across the latter into and up Rehoboth Bay; thence from the head of Rehoboth Bay, for about 8 miles, across Lewes and Rehoboth Hundred into Delaware Bay, at the Delaware Breakwater Harbor. The project, adopted in 1886, contemplated a dead-level tidal canal 70 feet wide at bottom, the depth to be made to 6 feet below the mean low-water level in the Delaware Breakwater Harbor, at an estimated cost of $350,000. This project was modified in 1892 so far as it relates to the section of the waterway situated between Rehoboth Bay and Delaware Bay by reducing the width at the bottom to 20 feet.

Up to the close of the fiscal year ending June 30, 1893, $69,182 had been expended. Little Assawaman and Indian River bays had been connected by a cut 20 feet wide and 4 feet deep, over which three temporary wooden bridges, provided with draws, were constructed, and the route between Rehoboth and Delaware bays had been located and the necessary land ceded to the United States by the State of Delaware. By this cession the appropriations of $50,000 and $25,000 of September 19, 1890, and July 13, 1892, respectively, became available, and a project to expend these amounts in dredging in the lower bays and in the Assawaman Canal and in excavating, as far as could be done with the funds on hand, a cut across the land north of Rehoboth Bay had been approved, and bids for the work had twice been invited with no satisfactory results.

New proposals were opened July 18, 1893. No satisfactory bid for dredging in the lower bays was received. The work north of Rehoboth

Bay was let to Patricius McManus, of Philadelphia, Pa. Work was commenced on August 5, 1893, and is still in progress. At the end of the fiscal year 232,823 cubic yards of material, sand and some little mud, had been excavated, and 2,300 feet of the proposed cut had been completed.

July 1, 1893, balance unexpended		$74,568.00
June 30, 1894, amount expended during fiscal year		49,198.44
July 1, 1894, balance unexpended		25,369.56
July 1, 1894, outstanding liabilities	$350.00	
July 1, 1894, amount covered by uncompleted contracts	18,500.00	
		18,850.00
July 1, 1894, balance available		6,519.56
Amount appropriated by act of August 17, 1894		25,000.00
Amount available for fiscal year ending June 30, 1895		31,519.56

Amount (estimated) required for completion of existing project	181,250.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	100,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

(See Appendix H 8.)

9. Susquehanna River above and below Havre de Grace, Md.—Before improvements were begun in this section of the river the least depth of water over the shoals between Havre de Grace and Spesutia Island was 5 feet at low water. The channel above Havre de Grace between Watson Island and the shoal running out from the west shore was narrow, and believed to be one of the causes of ice gorges at and near Port Deposit.

Improvements have been in progress since 1852. The present general project is for a 15-foot low-water channel below Havre de Grace and for the removal of the shoal opposite Watson Island to a depth of 8 feet below mean low water. Estimated cost, $168,000.

The channel below Havre de Grace was dredged the last time in 1885. It has shoaled again. The channel at Watson Island has been widened about 400 feet, but the shoal which was removed has nearly entirely reformed since the discontinuance of work in 1889.

Up to the close of the fiscal year ending June 30, 1893, $158,851.63 had been expended on this section of the river, including $49,729.15 for work for the Fish Commission.

There were no operations during the fiscal year ending June 30, 1894, the small amount available being limited to expenditure above the Philadelphia, Wilmington and Baltimore Railroad bridge, and regarded insufficient to bring about results permanent enough to justify its expenditure.

July 1, 1893, balance unexpended	$8,038.37
July 1, 1894, balance unexpended	8,038.37
Amount appropriated by act of August 17, 1894	4,000.00
Amount available for fiscal year ending June 30, 1895	12,038.37

Amount (estimated) required for annual dredging	20,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	20,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

(See Appendix H 9.)

10. Elk River, Maryland.—This river is a tributary of Chesapeake Bay, and is navigable for 17 miles, as far as the town of Elkton, in

Cecil County, where the average rise of tide is 2½ feet. Before improvements were begun in 1873 the least depth in the channel was 1¼ feet.

In 1884 a project, giving a channel 80 feet wide over the bar at Cedar Point, 3 miles below Elkton, and 70 feet wide from Cedar Point to the county bridge in the town, with a general depth of 7 feet at mean low water, was completed at an expense of $31,500. The channel near the bridge soon filled in again, reducing the depth to about 5 feet at low water.

The project for improvement adopted in 1890 provides for an 8-foot low-water channel, 100 feet wide, from the lower county bridge at Elkton to the club house, opposite Cedar Point, a distance of about 2 miles, at an estimated cost of $24,000. At the close of the fiscal year ending June 30, 1893, $11,504.06 had been expended, exclusive of outstanding liabilities, and the channel completed as projected.

July 1, 1893, balance unexpended	$3,495.94
June 30, 1894, amount expended during fiscal year	3,492.57
July 1, 1894, balance unexpended	3.37

(See Appendix H 10.)

11. Fairlee Creek, Maryland.—The original depth at the mouth before improvements were begun was 2 feet at low tide. Within the creek it was about 5 feet. Navigation was and still is carried on by a few flat-bottomed so-called lime boats and by one small schooner.

The existing project is for a 7-foot low-water channel 100 feet wide from deep water in Chesapeake Bay to a point about 3 miles above the mouth of the creek; also the conditional dredging of a turning basin at the upper end of the channel, the estimated cost being $15,558.

Up to the close of the fiscal year ending June 30, 1893, $10,000 had been expended and the channel, as proposed, from deep water in the bay to the mouth, had been completed and a portion of the channel inside the creek had been dredged to the required depth for a distance of 4,738 feet and for a width of 50 feet.

No appropriation was made for this creek in the last river and harbor act, and there were, consequently, no operations during the fiscal year ending June 30, 1894. There are as yet no indications that the commerce of the creek is increasing.

Amount (estimated) required for completion of existing project	$5,558.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	5,558.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix H 11.)

12. Chester River, Maryland, from Crumpton to Jones Landing.—This river is a tidal stream 40 miles long, forming the boundary line between Kent and Queen Anne counties, eastern shore of Maryland, and flows into Chesapeake Bay. It is navigable for vessels drawing 6 feet of water at low tide as far as Crumpton, about 33 miles above the mouth. The least depth of water within the last 7 miles of the river is 3 feet. At Crumpton the average rise of the tide is 2.1 feet. A short distance from this town several shoals have previously been improved by the United States.

The existing project for improvement is for a 6-foot low-water channel 60 feet wide from Crumpton to Jones Landing, a distance of 6¼ miles, at an estimated cost of $12,750.

Up to the close of the fiscal year ending June 30, 1893, $7,958 had been expended improving the channel for about 4¾ miles, and regular trips are now made by vessels trading in the river. The dredged channel is in good condition; it does not as yet extend far enough, however, to have any marked influence upon the commerce of the river.

No work was done during the fiscal year 1894, the funds provided by the appropriation of 1892 having been used early in 1893.

July 1, 1893, balance unexpended	$42.00
June 30, 1894, amount expended during fiscal year	33.67
July 1, 1894, balance unexpended	8.33
Amount appropriated by act of August 17, 1894	1,500.00
Amount available for fiscal year ending June 30, 1895	1,508.33
Amount (estimated) required for completion of existing project	3,250.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	3,250.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix H 12.)

13. Choptank River, Maryland.—Before improvements were begun in 1879 the depth of water in the channel between Denton and Greensboro varied from 2 to 8 feet at low water. Navigation carried on by small sailing vessels extended only to 3 miles above Denton. Upon the remaining 5 miles, to Greensboro, all freight had to be transported upon scows.

A project for improvement was made in 1880 for an 8-foot low-water channel, 75 feet wide, the estimated cost being $79,000. The project was adopted the same year. Since that time the channel has been dredged at various points to depths of 6, 7, and 8 feet, and for a width of 40 feet only. Up to the close of the fiscal year ending June 30, 1893, $48,000 had been expended in making a channel not less than 75 feet wide and 7½ feet deep between Greensboro and the Brick Mills, a distance of about 4 miles. The remaining 4 miles, to Denton, have been partly improved by dredging the channel, where needed, to a depth of 5 and 6 feet and widening it to about 40 feet. This section and several points in the upper river remain, therefore, to be dredged to the proposed width and depth, 75 feet and 8 feet, respectively. Shortly after the main obstructions had been removed, in 1887, steamboat navigation with Baltimore was established, and since that time commerce has steadily increased.

No work was done the past fiscal year, all available funds having been expended on the project the previous fiscal year.

Amount appropriated by act of August 17, 1894	$2,000.00
Amount (estimated) required for completion of existing project	18,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix H 13.)

14. La Trappe River, Maryland.—This river, formerly called Dividing Creek, is in Talbot County, Eastern Shore of Maryland, and flows into the Choptank River, one of the larger tributaries of Chesapeake Bay. It is about 3 miles long and has no fresh-water inflow at the head, and was originally only 4 feet deep. The entrance to the river was seriously obstructed by several shoal bars, with a least depth of 9 feet in the narrow channel, which was very tortuous and about one-half of a mile long. The average rise of the tide is 1.55 feet.

Previous to the adoption of the present project the sum of $5,333.50, raised by private subscription, had been expended in dredging at the head of the river and at the bar at the mouth. The average depth in the river was thereby increased to 8 feet and the channel at the mouth was somewhat widened.

The present project for improvement, which was proposed in a report on a survey made in 1891, provides for a channel 150 feet wide and 11 feet deep across the bar at the mouth and for a channel 75 feet wide and 8 feet deep at mean low water inside the river as far as Trappe Landing, situated at the head of navigation, and a turning basin at the latter point. The estimated cost is $7,250.

An appropriation of $2,500 was made for this work by the river and harbor act approved July 13, 1892.

Up to the close of the fiscal year ending June 30, 1893, $2,496.30 had been expended, and the channel across the mouth had been dredged to a width of 100 feet and a depth of 11 feet at mean low water. The channel is of great benefit to the steamers, which usually enter and leave the river during the night time.

No work was done during the past fiscal year, for want of funds.

July 1, 1893, balance unexpended	$3.70
July 1, 1894, balance unexpended	3.70
Amount appropriated by act of August 17, 1894	4,750.00
Amount available for fiscal year ending June 30, 1895	4,753.70

(See Appendix H 14.)

15. Warwick River, Maryland.—This river, formerly named Secretary Creek, is in Dorchester County, Eastern Shore of Maryland, and flows into the Choptank River, one of the large tributaries of Chesapeake Bay. It is a small tidal basin 2 miles long, with no fresh-water influx at the head, and was originally only 4 feet deep. The average rise of the tide is 1.7 feet.

Before the adoption of the present project about $12,000 had been expended in the improvement of this river, $6,000 by the General Government and the remaining amount by private parties.

The present project for improvement, which was proposed in a report on a survey made in 1891, provides for a channel 100 feet wide and 10 feet deep at mean low water from the 10-foot depth in Choptank River to Secretary Landing, at the head of the river, including a turning basin at the latter point, at an estimated cost of $18,600.

An appropriation of $6,000 for this work was made by the river and harbor act approved July 13, 1892.

Up to the close of the fiscal year ending June 30, 1893, $5,991.23 was expended on this project, and 4,400 feet of the channel as approved had been completed, beginning in the Choptank River outside the mouth of the river, and part of the turning basin at Secretary Landing deepened to 10 feet. The obstructions at the entrance, which formerly seriously impeded navigation during low tides and high northwesterly winds, are now removed, but the channel inside the river remains to be improved.

No work was done during the fiscal year 1894, all the available funds having been used on the project in the previous fiscal year.

July 1, 1893, balance unexpended	$8.77
July 1, 1894, balance unexpended	8.77
Amount appropriated by act of August 17, 1894	2,000.00
Amount available for fiscal year ending June 30, 1895	2,008.77

Amount (estimated) required for completion of existing project	$10,600.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	6,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix H 15.)*

16. Cambridge Harbor, Maryland.—The entrance to this harbor had originally a depth of water of only 4½ feet at low tide. Within the harbor the depth was about 3 feet upon an average. During strong northwesterly winds vessels drawing over 3 feet of water could not cross the bar. The local commerce was carried on by a limited number of small sailing vessels and one steamer of light draft.

Previous to 1871 the citizens of Cambridge expended $7,500 in dredging the harbor. In that year the General Government began improvements under a project completed in 1879, resulting in a channel not less than 100 feet wide across the bar and 8 feet in depth, certain portions of the inner harbor being dredged to the same depth at the same time. The channel across the bar was increased in width somewhat in 1884 with the $2,500 appropriated in 1879. The amount expended under this project was $32,500.

The present project is based upon a survey in 1887 and was adopted in 1888. It provides for a channel 12 feet deep at mean low water, having a width of 150 feet from the 12-foot depth in the Choptank River to the railroad wharf, and for dredging the irregular area of the inner harbor below and above the bridge to a depth of 10 feet and 8 feet below mean low water, respectively, at an estimated cost of $17,736.60.

At the close of the fiscal year ending June 30, 1893, $6,028.89 had been expended and operations were in progress. On that date the 12-foot channel from the Choptank River to the railroad wharf had been completed and about one-fourth the area of the harbor below the bridge had been deepened to 10 feet.

Work continued during the first month of the past fiscal year until the 24th, when the contract was closed. The remaining shoal area of the harbor below the bridge was dredged to the approved depth of 10 feet and the 12-foot channel previously dredged was slightly widened at a turn which it makes at the entrance to the harbor.

The harbor above the bridge remains to be dredged to complete the project. The funds now available are sufficient for that purpose, but are withheld until the county authorities widen the draw in the bridge crossing the upper harbor.

July 1, 1893, balance unexpended	$11,708.11
June 30, 1894, amount expended during fiscal year	4,846.17
July 1, 1894, balance unexpended	6,861.94

(See Appendix H 16.)

17. Broad Creek River, Delaware.—This river is a tidal stream and a tributary of the east fork of the Nanticoke River, which flows into the Chesapeake Bay. It is wholly in the western portion of Sussex County, Del., its navigable length being about 7 miles; Laurel, a growing manufacturing town, is at the head of navigation.

Broad Creek River, formerly named Broad Creek, has previously been improved by the General Government. Before improvements were commenced in 1881, the low-water depth at Laurel was 2 feet; below the town it was in some places only 1½ feet. At the close of the year 1889, when the original project was completed, a channel 6 feet deep at mean low water and 50 feet wide had been dredged from Bethel to

Laurel, a distance of nearly 3 miles, and contributed toward making Laurel an important shipping point on the peninsula. The cost of these improvements was $35,000; but the rapidly increasing commerce on the river demanded an enlargement of the channel.

The project for improvement proposed in a report upon an examination made to comply with requirements of the river and harbor act approved September 19, 1890, provides for dredging a channel 70 feet wide and 8 feet deep at mean low water from Bethel to the head of navigation at Laurel, at an estimated cost of $15,000.

An appropriation of $5,000 for this work was made by the river and harbor act approved July 13, 1892.

Up to the close of the fiscal year ending June 30, 1893, $4,900.45 had been expended, and 6,455 feet of the channel as approved had been completed above Bethel, and an additional cut was made 8 feet deep but only 40 feet wide for a length of 215 feet across a shoal situated just beyond the section of the channel that had been dredged to the full width, and navigation at several sharp turns in this section of the river was thereby much improved.

No work was done during the fiscal year 1894 for want of funds.

July 1, 1893, balance unexpended	$99.55
June 30, 1894, amount expended during fiscal year	88.60
July 1, 1894, balance unexpended	10.95
Amount appropriated by act of August 17, 1894	5,000.00
Amount available for fiscal year ending June 30, 1895	5,010.95
Amount (estimated) required for completion of existing project	5,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	5,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix H 17.)

18. *Wicomico River, Maryland.*—The portion of the river at and just below Salisbury has been under improvement by the United States since 1872. At that time the navigable channel, with a minimum depth of 8 feet at low water, extended to 2 miles below, or within 2 miles of, Salisbury. The extreme upper portion as far as the mill-dam in the heart of the town was quite shoal, and had an average depth of only 18 inches at low tide. Between 1872 and 1885 a channel 75 to nearly 100 feet wide and 7 feet deep at low water was dredged from deep water below to the drawbridge in the town, at a cost to the Government of about $49,000.

The present project, demanded by the remarkable increase in the shipping and dependent industries, is based upon a survey of the river made in 1889. It provides for a channel 9 feet deep at mean low water from that depth below to the drawbridge at Salisbury, the width to be from 100 to 150 feet, at an estimated cost of $23,200.

On June 30, 1893, $10,394.99 had been expended, and a cut had been made 30 feet wide and 9 feet deep from the lower to the upper end of the section which is under improvement.

During the past fiscal year the cut was widened to the approved width of the channel from the dock of the Maryland Steamboat Company to Island Point, a distance of about 4,000 feet, the least depth made being 9 feet. About one-half the length of the channel remains to be completed. The improvements made so far have increased the harbor room and give greater facilities to vessels entering and leaving.

July 1, 1893, balance unexpended	$7,062.07
June 30, 1894, amount expended during fiscal year	6,710.74
July 1, 1894, balance unexpended	351.33
Amount appropriated by act of August 17, 1894	3,000.00
Amount available for fiscal year ending June 30, 1895	3,351.33
Amount (estimated) required for completion of existing project	3,700.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	3,700.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

(See Appendix H 18.)

19. Manokin River, Maryland.—Before improvements were commenced in 1891, the depth of water at the mouth of the river, at the so-called "Mud Flats," was between 1 and 2 feet at low tide. These flats are about 2½ miles wide, and made navigation, except at high water, impossible, thereby rendering the upper part of the river, which has a very fair depth and width, almost useless for extensive shipping purposes. The average rise of the tide at the flats is 2.6 feet.

The adopted project for improvement is for a channel 6 feet deep at mean low water and 100 feet wide from Locust Point to Sharp Point, embracing the section called the "Mud Flats," at an estimated cost of $30,000.

Up to the close of the fiscal year ending June 30, 1893, $14,360.05 had been expended, and the proposed cut across the "Mud Flats" had been made for a width of 60 feet and a depth of 6 feet at low water, which opened the river for navigation during low tide. Several sharp points in the upper river, above Sharp Point, were also removed and navigation upon the whole river at low tide was thereby greatly improved.

During the fiscal year 1894 no work was done for want of funds.

July 1, 1893, balance unexpended	$639.95
June 30, 1894, amount expended during fiscal year	175.00
July 1, 1894, balance unexpended	464.95
Amount appropriated by act of August 17, 1894	4,000.00
Amount available for fiscal year ending June 30, 1895	4,464.95
Amount (estimated) required for completion of existing project	11,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	10,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

(See Appendix H 19.)

20. Onancock Harbor, Virginia.—Onancock Harbor, or Onancock River, is about 5 miles long and flows through a portion of Accomac County, Va., into Chesapeake Bay. The original depth at the head of the river was 4 feet at mean low water, and at the mouth, which is obstructed by a wide bar, it was 5 feet. The average rise of the tide is 2 feet.

In 1879, $3,000 was appropriated and expended in dredging a channel at the bar 100 feet wide and 8 feet deep. After a lapse of ten years the width had been reduced to 50 feet and the depth to 5½ feet, caused by fine sand rolling into the cut under the impulse of littoral currents coming down the north shore. An appropriation of $5,000, made in 1880, was expended under the same project in dredging inside the creek. The improvements made then are more permanent.

The present project for improvement, adopted in 1890, provides for an 8-foot low-water channel 300 feet wide at the outer bar and 200 feet wide at the inner bar, called the "Middle Ground." The estimated cost is $12,511. At the close of the fiscal year ending June 30, 1893, $5,931.40 had been expended on this project and a channel of one-half the proposed width had been dredged at both bars to a depth of 8 feet.

During the past fiscal year the channel as proposed was completed. That at the outer bar was made 300 feet wide and that at the inner bar 200 feet; in both cases the depth made was 8 feet at mean low water. The difficulties experienced by vessels in entering or leaving Onancock Harbor have been very much lessened by these improvements, but as the causes which formerly tended to close the dredged channel still prevail, it is believed that the channel will eventually resume its original depth of 5 feet.

The project having been completed no further funds for it are needed.

July 1, 1893, balance unexpended	$6,579.60
June 30, 1894, amount expended during fiscal year	6,579.60

(See Appendix H 20.)

21. Harbor and approaches at Cape Charles City, Va.—This harbor is an artificial rectangular basin of about 10 acres area, originaly excavated to a depth of 12 feet in a pond just back of the shore of Chesapeake Bay, about 12 miles north of Cape Charles. It is in Northampton County and forms the shore terminus of the New York, Philadelphia and Norfolk Railroad, transfer of passengers and freight being made by boat to and from Norfolk, Va. The tide rises on an average 2.6 feet.

The project for improvement propose in a report on a survey made in 1889 provides for dredging the harbor to a depth of 14 feet; and the entrance thereto and the channels in Cherrystone Inlet and across Cherrystone Bar to a depth of 16 feet below mean low water, the width at the inlet and bar to be 100 and 200 feet, respectively, and for protective works of stone at the entrance. The estimated cost of the project is $142,340, of which $45,400 is for dredging.

The dredging project was adopted in 1890, and at the end of the fiscal year ending June 30, 1893, $23,110.93 had been expended in dredging about one-half of the area of the harbor to a depth of 14 feet; in widening the channel in the entrance and deepening it to 16 feet, and in removing part of the shoal in Cherrystone Inlet, about a mile below the harbor, to the same depth. The improvements are of great benefit to the large class of vessels that daily leave and enter the harbor.

The dredged channels are supposed to be in a fair condition except the one at the entrance, which has partially shoaled again, and needs protective works.

No work was done during the past fiscal year, and the appropriation of $10,000, made July 13, 1892, is still on hand, as the owners have not yet filed an acceptance of the conditions upon which the appropriation was made.

July 1, 1893, balance unexpended	$11,889.07
June 30, 1894, amount expended during fiscal year	100.00
July 1, 1894, balance unexpended	11,789.07
Amount (estimated) required for completion of existing project	$10,400.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	10,400.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix H 21.)

22. Removing sunken vessels or craft obstructing or endangering navigation.—Wreck of tugboat *Charles Lea*, Mispillion River, Delaware. This wreck, for the removal of which preparations were begun in June, 1893, was broken up and landed above high-water mark in September, 1893, at a total cost of $123.53.

Obstruction caused by a sunken schooner off Kent Island, Chesapeake Bay. This was removed July 21, 1893, at a cost of $34.29.

Wreck of canal boat *J. D. Hilton*, Christiana River, Delaware. Removal completed February 23, 1894, at a cost of $397.90.

Wreck of canal boat *Loring Monroe*, sunk in Brandywine Creek, Delaware. Examined and reported upon May 31, 1894. Under authority from the Chief of Engineers, its removal was begun June 29, 1894, and at the end of the fiscal year the work was still in progress.

(See Appendix H 22.)

IMPROVEMENT OF PATAPSCO RIVER AND BALTIMORE HARBOR, MARYLAND, AND JAMES RIVER, VIRGINIA.

These works were in the charge of Col. William P. Craighill, Corps of Engineers.

1. Patapsco River and channel to Baltimore, Md.—The depth of this channel has by successive steps been increased from 17 feet at mean low water to 27 feet, with an average rise of tide of about 18 inches.

The project of improvement first adopted and commenced in October, 1853, had for its object to give a channel 22 feet deep at mean low water, with a width of 150 feet.

Little was done before the late war, but afterwards these dimensions were increased, a depth of 24 feet at mean low water being determined upon, with a width of channel ranging from 250 to 400 feet.

This channel was completed in 1874, important changes of position having been given to a portion of it, by which the distance was materially lessened and the expense of maintenance decreased.

The object of the improvement was to permit the approach to Baltimore, at mean low water, of vessels drawing from 22½ to 23 feet, and at ordinary high water of vessels drawing 24 and 24½ feet. Later the project had in view a depth of 27 feet at mean low water, with a width of 600 feet, to allow the entrance and departure of the largest vessels.,

Up to June 30, 1893, the United States had expended $3,186,215.10. The city of Baltimore and the State of Maryland, chiefly the former, have also contributed to the same object more than $500,000. The expenditure up to June 30, 1894, by the United States was $3,203,956.47.

In 1890 Congress gave authority for contracting for the completion of the work, which was accomplished in 1892, the channel being made 600 feet wide and 27 feet deep throughout at mean low water, the width being much greater at the turns.

A careful survey made in 1893 shows that the channel was in good condition, but it will require repairs from time to time, like all other artificial highways. For its maintenance in good order the sum of $50,000 will be annually needed. This is, however, a small sum when contrasted with the great gain to Baltimore and her dependent interests, as well as in revenue to the United States Treasury, by the increase of the depth from 17 to 27 feet at low water, which means the introduction of many lines of deep-ocean steamers to European and other foreign and domestic ports within the past twenty years, whereas there were none before of any importance. The expense of repairs is increased if they are not regularly and systematically made.

July 1, 1893, balance unexpended	$20,612.06
June 30, 1894, amount expended during fiscal year	17,741.37
July 1, 1894, balance unexpended	2,870.69
July 1, 1894, outstanding liabilities	600.00
July 1, 1894, balance available	2,270.69
Amount appropriated by act of August 17, 1894	50,000.00
Amount available for fiscal year ending June 30, 1895	52,270.69
Amount that can be profitably expended in fiscal year ending June 30, 1896	100,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix I 1.)

2. Channel to Curtis Bay, in Patapsco River, Baltimore Harbor, Maryland.—The river and harbor act of 1892 contained the following item:

> Improving Patapsco River, Baltimore Harbor, Maryland: For dredging a channel 150 feet wide at bottom and of a depth of 27 feet, mean low water, from the main ship channel to Curtis Bay, in accordance with recommendation of Col. William P. Craighill, Corps of Engineers, submitted December 13, 1890, $28,000.

The total estimated cost of the improvement was $85,000. The first appropriation of $28,000 was expended in dredging to a depth of 25 feet at low water, under a contract with the National Dredging Company; work was commenced in November, 1892, and, after considerable interruption by ice and severe weather, was satisfactorily completed in May, 1893. The channel was made 150 feet wide.

Amount appropriated by act of August 17, 1894	$12,000.00
Amount (estimated) required for completion of existing project	45,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	45,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix I 2.)

3. James River, Virginia.—When the improvement of the James River was regularly undertaken by the Government the navigation was obstructed by sunken vessels, by remains of military bridges, and by other obstructions put into the river during the late war to prevent the national fleets from approaching too close to Richmond.

There were also other natural obstructions. Rockett Reef and Richmond Bar had only 7 feet of water at mean low tide. From Warwick Bar to Richmond the channel was crooked and obstructed by dangerous rocks and ledges. The Dutch Gap Cut-off was not then open, and the river was in a poor condition as regards its availability for commercial purposes.

The original project of improvement was to secure a depth of 18 feet at full tide (corresponding to about 15 feet at low tide) to Richmond, with a channel width of 180 feet. This project had reached an advanced state of progress when Congress, by act approved July 5, 1884, adopted another looking to 22 feet at mean low tide from the sea to Richmond, the width to be 400 feet from the sea to City Point, 300 from thence to Drewry Bluff, and 200 feet from thence to Richmond.

The total amount expended on this river by the United States up to June 30, 1893, was $1,382,875.88, which includes the sum of $651,991.33 expended since the new project was entered upon to give a depth of 22 feet at mean low water. The condition of the river June 30, 1893, is shown by the table below, the depth being given at mean low water, as also, for comparison, the depths in 1870, before the improvement was begun, with a channel width not less than 80 feet:

	Length.	1870.	1893.
	Miles.	*Feet.*	*Feet.*
From the city to Goodes Rocks	2	8	16
Goodes Rocks Ledge*	.25	7	13.8
Richmond Bar	.75	7	16
Richmond Bar to Drewry Bluff	3.75	9	18
Drewry Bluff to Curles Neck (least depth being in Trents Reach, Dutch Gap Cut-off not being open)	14	7	15.5
Curles Neck to Hampton Roads	80	14.8	17

* A cut 20 feet deep, 55 feet wide, is completed through this ledge and being widened to 80 feet under an existing contract.

The amount expended in the year ending June 30, 1894, is $73,907.26.

The most expensive and tedious part of the improvement is near the city of Richmond, where the depth of water is least, and much of the material to be removed to give greater depth is rock. When the material is such that an increase of velocity given by contracting and regulating works can remove it, and thus obtain and then maintain the required depth, these works have been successful and the results good. The conditions are now such that the best results can be obtained from liberal appropriations.

In the fiscal year a contract has been in force with Mr. John A. Curtis, dated October 15, 1892, and is to be completed December 1, 1894.

The work required under the contract with Mr. Curtis included the enlargement of the channel between Richmond city limits and Goodes Rocks to not less than 80 feet wide and 18 feet deep; the widening of Goodes Rocks cut to 80 feet and the channel through Richmond Bar to 80 feet by 18 feet; the deepening of Dutch Gap Cut-off to 25 feet for 100 feet of its width, and redredging and enlarging the channels at Harrisons Bar and Goose Hill Flats to 200 by 18 feet. In works of regulation the wing dams on Richmond Bar and from Warwick Bar to Drewry Bluff were to be extended to new lines of contraction, and wing dams constructed for the first time in Wards Reach, Willis Reach, and at Curles. Two of the wing dams at Varina, built in 1880 and shortened by the freshet of 1886, were to be restored, and new wing dams constructed on the right bank covering the whole length of the shoal, to produce further contraction and scour out the channel 300 by 22 feet, required by the project of 1884. The openings in training walls below Richmond Bar and in Kingsland Reach were to be closed.

Mr. Curtis, in the fiscal year 1894, has done the following work:

Locality.	Earth.	Cobble.	Soft rock.	Solid rock.	Total.
	Cub. yds.	*Cub. yds.*	*Cub. yds.*	*Cub. yds.*	*Cub. yds.*
Richmond to Stearns Dike	1,577.6	51.6	6,556.8	1,801	9,987
Stearns Dike to Goodes Rocks	1,932.8	64.3	5,722.6	200.9	7,920.6
Goodes Rocks	489.8	14	954.8	2,299.8	3,758.4
Dutch Gap Cut-off	11,589.6				11,589.6
Total	15,589.8	129.9	13,234.2	4,301.7	33,255.6

Seven thousand one hundred and forty and four-tenths linear feet wing dams built, and 531.3 linear feet renewals and repairs.

The condition of the channel June 30, 1894, is shown by the following table, the depths being at mean low water in a channel not less than 80 feet wide, the minimum width being in rock.

	Miles.	1870.	1894.
		Feet.	*Feet.*
Richmond to Goodes Rocks	2	8	16
Goodes Rocks	.25	7	13.8
Richmond Bar	.75	7	16
Richmond Bar to Drewry Bluff	3.75	9	18
Drewry Bluff to Curles	14	14	16.7
Curles to Hampton Roads	80	14.8	17
Total	100.75	....	....

The present available depth for navigation at full tide is 19½ feet from the sea to Richmond Bar, and 16½ feet thence to city limits of Richmond.

When the proposed improvement is completed, an annual expenditure of $20,000 will be necessary for the maintenance of the channel.

July 1, 1893, balance unexpended		$181,587.33
June 30, 1894, amount expended during fiscal year		73,907.26
July 1, 1894, balance unexpended		107,680.07
July 1, 1894, outstanding liabilities	$2,000.00	
July 1, 1894, amount covered by uncompleted contracts	69,687.32	
		71,687.32
July 1, 1894, balance available		35,992.75
Amount appropriated by act of August 17, 1894		100,000.00
Amount available for fiscal year ending June 30, 1895		135,992.75
Amount (estimated) required for completion of existing project		3,236,070.45
Amount that can be profitably expended in fiscal year ending June 30, 1896		400,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

(See Appendix I 3.)

IMPROVEMENT OF POTOMAC RIVER AND ITS TRIBUTARIES, AND OF CERTAIN RIVERS IN MARYLAND AND VIRGINIA ON WESTERN SHORE OF CHESAPEAKE BAY.

This district was in the charge of Maj. Charles E. L. B. Davis, Corps of Engineers, with Lieut. George A. Zinn, Corps of Engineers, under his immediate orders to May 4, 1894; Division Engineer, Col. William P. Craighill, Corps of Engineers.

1. *Potomac River at Washington, D. C.*—Before the commencement of this improvement the channel to Georgetown, D. C., was narrow and crooked, and had not sufficient depth to meet the needs of commerce. Vessels drawing 16 feet frequently grounded at high tide above Long bridge, and frequent dredging was necessary to maintain even this depth. The channel was of insufficient width, as the appropriations for dredging were too small to provide for more than a narrow cut through the bar. The Washington Channel was narrow and shoal, and inadequate to the wants of commerce. Extensive mud flats existed along the city front from Observatory Hill to a point opposite the

Arsenal. Below Long bridge these flats were separated from the city front by the Washington Channel. The greater portion of these flats was exposed at low tide and covered at high tide with water polluted by the sewage of the city. At the foot of Seventeenth street NW. a large sewer discharged directly upon the flats. These conditions rendered a portion of the city almost uninhabitable.

By act passed August 2, 1882, Congress adopted a project which has for its object the improvement of the navigation of the river by widening and deepening its channels, the reclamation or filling of the marshes on the city front by depositing on them the material dredged from the channels, and the establishment of harbor lines beyond which no wharves or obstructions should be built. The project provides in detail for such depths of channels as will accommodate the largest vessels that can reach Arsenal Point, with such depth at the wharves as will allow vessels to receive full cargoes without grounding at low water; for filling the flats above Long bridge to a height of 3 feet above the flood line of 1877, and the middle part of the flats below Long bridge to the same height, but sloping each way to a height of 6 feet above low tide at the margin of the fill; that, in order to purify the water in the Washington Channel, which will be cut off at its upper end from the Virginia, or main channel, a tidal reservoir or basin be established above Long bridge, to be filled with water from the Virginia Channel on the flood tide and discharged into the Washington Channel on the ebb.

The plan also contemplates the rebuilding of Long bridge with longer spans and fewer piers during the progress of the work, and the interception of all sewage now discharged into Washington Channel and its conveyance to James Creek, but neither the reconstruction of the bridge nor the building of the intercepting sewer were included in the estimate of the cost of the improvement.

The estimated cost of the improvement is $2,716,365.

Up to the close of the fiscal year 1893 the expenditures aggregated $1,843,165.85, and the following work had been accomplished: The Virginia Channel above Long bridge had been deepened to 20 feet at low tide for a width of from 400 to 550 feet, a part of which has since filled up and been redredged to a width of 250 feet. The Virginia Channel immediately below Long bridge had been widened, the depth made being 20 feet. The bar in the same channel below Long bridge had been dredged to a depth of 20 feet and a width of about 350 feet. This part of the Virginia Channel has maintained itself to the full depth originally dredged, or has deepened. The Washington Channel had been dredged to a depth of 20 feet for a width of 350 feet throughout its entire length and to a depth of 12 feet from the 20-foot channel nearly to the easterly margin of the fill, except a small area near the Seventh street wharf. This channel for the most part maintained itself until the freshet of June, 1889, when considerable filling took place. The junction of the Virginia and the Washington channels had been dredged to depths of 20 feet, 15 feet, and 12 feet. The greater part of the tidal reservoir had been dredged to a depth of 8 feet. The material dredged from the river, 9,465,200 cubic yards in all, had been deposited on the flats. The entire area of the flats, about 621 acres, had been outlined, and practically the entire area to be reclaimed had been raised to a height of 6 feet above low tide.

The riprap foundation for the sea wall had been put in place around the entire river front of the reclaimed area and the margin of the tidal reservoir. The construction of the sea wall, for the protection of the margin of the fill from erosion by the waves and the action of the tidal currents, had been commenced and about 18,290 linear feet of wall constructed. The construction of a dike on the westerly side of the Virginia Channel above Long bridge, with a view to reducing the deposit at that locality, was in progress. The outlet gates at the tidal reservoir at the head of the Washington Channel had been completed, with the exception of the railing.

During the fiscal year ending June 30, 1894, the construction of the sea wall was continued and 7,205 linear feet built, making a total to date of 25,495 linear feet.

In the Washington Channel, the anchorage ground between the navigation channel and the wall—dredged to a depth of 12 feet—has been completed. The navigation channel has been redredged and widened for a length of 6,297 linear feet, the width being generally 400 feet and the depth 20 feet.

The unfinished portion of the tidal reservoir was dredged to the required depth of 8 feet at low tide.

The channel dredged in 1892 through the upper bar in the Virginia Channel above Long bridge was found to have filled in by freshets, and has been partly redredged to a depth of 20 feet.

Work on the training dike on the west side of the Virginia Channel has been continued.

Long bridge.—On June 30, 1892, the northerly end of the Long bridge across the Washington Channel had been nearly reconstructed by the Baltimore and Potomac Railroad Company on plans approved by the Secretary of War, the work being incomplete owing to the settlement and movement of the abutments.

Reference is made in the report of the officer in local charge to the necessity of rebuilding Long bridge. In event of a freshet occurring when the Potomac River is full of ice great damage is to be expected. The piers of the bridge are of such faulty construction that an ice gorge would be probable, which would cause the water to back up and overflow portions of the city front and through the sewers above the bridge such portions of the lower parts of the city as may be drained by them. Great damage was done by the freshet of June, 1889, but greater damage may occur from a freshet of lesser magnitude if accompanied by an ice gorge.

A plan for the reconstruction of the bridge was submitted to Congress April 5, 1890.

July 1, 1893, balance unexpended		*$191,834.15
June 30, 1894, amount expended during fiscal year		140,301.83
July 1, 1894, balance unexpended		51,532.32
July 1, 1894, outstanding liabilities	$666.00	
July 1, 1894, amount covered by uncompleted contracts	19,122.00	
		19,788.00
July 1, 1894, balance available		31,744.32
Amount appropriated by act of August 17, 1894		150,000.00
Amount available for fiscal year ending June 30, 1895		181,744.32
Amount (estimated) required for completion of existing project		531,365.00
Amount that can be profitably expended in fiscal year ending June 30, 1896		531,365.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

(See Appendix J 1.)

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*In the Annual Report for 1893 the balance available for "Eastern Branch" of the Potomac River was included in this statement.

2. Anacostia River, District of Columbia.—The channel of the Anacostia River, District of Columbia, was obstructed between its mouth and the Washington navy-yard by three bars, on two of which there were ruling depths of 18 feet, and on the third a ruling depth of about 19 feet. The channel is exceedingly narrow and tortuous and vessels of moderate length navigate it with difficulty.

The project for the improvement of the Anacostia River provides for dredging a channel 24 feet deep and 200 feet wide from its mouth to the navy-yard bridge, the channel to be widened with a reduced depth to 1,000 feet, as the demands of commerce require.

In front of the navy-yard a basin is proposed 400 feet wide and 24 feet deep. The material dredged is to be deposited on the flats of the river, and the estimated cost of the improvement is $656,000.

Up to June 30, 1893, $18,121.94 had been expended, and channels 200 feet wide and 20 feet deep were dredged through two shoals. A basin from 100 to 200 feet wide and 22 feet deep has been dredged at the navy-yard by the Navy Department. No work has been done during the fiscal year ending June 30, 1894, for want of funds.

July 1, 1893, balance unexpended	*$1,878.06
June 30, 1894, amount expended during fiscal year	105.00
July 1, 1894, balance unexpended	1,773.06
Amount (estimated) required for completion of existing project	636,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	200,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix J 2.)

3. Occoquan Creek, Virginia.—Occoquan Creek is a tributary of the Potomac River, which it enters about 25 miles below Washington, D. C. Navigation was obstructed by four bars, which were improved between 1873 and 1880 by the expenditure of four appropriations, aggregating $25,000, giving a navigable depth of about 6 feet to Occoquan, the head of navigation, 4 miles above the mouth. When the original survey was made, November, 1872, the ruling depths over the several bars were as follows: Lower Mud, 2.7 feet; Sand Bar, 4 feet. Occoquan Bar does not appear to have been in existence. A narrow channel had been dredged by the citizens at the Upper Mud, having a depth of 6 feet. In compliance with the provisions of the river and harbor act of August 11, 1888, a new survey was made in 1889, and the condition of the several bars found as follows:

Lower Mud, about 3.5 miles below Occoquan. This bar is about 4,000 feet long and had a ruling depth of about 3 feet. The former dredged channel had filled in.

Upper Mud, about 2.25 miles below Occoquan. The channel dredged in 1874–'75 was found to have maintained its original dimensions, being about 50 feet wide and from 5 to 6 feet deep.

Sand Bar, about one-half mile below Occoquan. The former dredged channel had filled in, the least depth being 4.2 feet.

Occoquan Bar, a short bar opposite Occoquan. The channel dredged here had filled in, and the least depth was 4 feet.

The project for the new improvement comprises the dredging of channels 6 feet deep and from 100 to 150 feet wide through the bars, with the construction of such dikes as may be required to maintain the depth secured by dredging. The first appropriation for the new work was made September 19, 1890. At the close of the fiscal year ending June 30, 1893, $12,506.32 had been expended. At that date a channel 6 feet deep and from 100 to 150 feet wide had been dredged through the Lower Mud. A part of the channel at the Upper Mud had been deepened to 6 feet and widened to 100 feet. A width of 100 feet and a depth of 6 feet had been secured at the Sand Bar. A channel 8 feet deep and 100 feet wide had been dredged through Occoquan Bar, and the dike at Occoquan Bar had been nearly completed.

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* In the annual report for 1893 the balance available for this improvement was included in the statement for Potomac River.

The amount expended during the fiscal year ending June 30, 1894, has resulted in the completion of 1,350 linear feet in all of the channel of the Upper Mud to the required dimensions of 100 feet in width and 6 feet in depth.

July 1, 1893, balance unexpended	$2,493.68
June 30, 1894, amount expended during fiscal year	1,926.98
July 1, 1894, balance unexpended	566.70
Amount appropriated by act of August 17, 1894	5,000.00
Amount available for fiscal year ending June 30, 1895	5,566.70
Amount (estimated) required for completion of existing project	25,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	25,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

(See Appendix J 3.)

4. *Aquia Creek, Virginia.*—Aquia Creek is a tributary of the Potomac River, which it enters about 41 miles below Washington, D. C. The stream is about 7 miles long, and in 1872 its navigation was chiefly obstructed by shoals between the mouth and the "Narrows," 4.5 miles above. Here the creek takes the character of a wide bay, from 1,000 to 6,000 feet wide, while the depth of water ranged from 2 to 4 feet over an almost continuous shoal of soft mud. Above the "Narrows" the creek is from 60 to 200 feet wide, with a depth of from 2 to 17 feet, the shoaler portions being near the head of navigation. The stream is crossed by a bridge of the Richmond, Fredericksburg and Potomac Railroad, about 3 miles above the mouth, the draw of the bridge being but 28 feet wide.

From 1872 to 1878 appropriations amounting to $10,000 were made by Congress, and the navigation improved by dredging a channel from 40 to 50 feet wide, and from 4 to 5 feet deep, through the shoaler parts of the creek, chiefly above the railroad bridge.

A new survey of the creek was provided for in the river and harbor act of August 11, 1888, and was made in 1889. The channel dredged from 1872 to 1878 was found to have maintained its dimensions between the railroad bridge and the "Narrows," but at other places it had filled in. The general depth of water in the creek remained substantially as in 1872. Estimates for improving the navigation were submitted January 18, 1890, and an appropriation of $10,000 made by the river and harbor act of September 19, 1890.

The project for the improvement, approved December 4, 1890, proposes a channel 80 feet wide and 6 feet deep, dredged through the shoals where less than 6 feet is found between the mouth of the creek and the "Narrows."

At the close of the fiscal year ending June 30, 1893, $10,014.25 had been expended. A channel 80 feet wide and 6 feet deep had then been dredged from Thorny Point, at the lower end of the shoal, up to the railroad bridge, a distance of 12,280 feet.

During the fiscal year ending June 30, 1894, a channel 80 feet wide and 6 feet deep has been dredged for a distance of 3,823 feet above the railroad bridge.

July 1, 1893, balance unexpended	$4,985.75
June 30, 1894, amount expended during fiscal year	3,550.98
July 1, 1894, balance unexpended	1,434.77
Amount appropriated by act of August 17, 1894	3,000.00
Amount available for fiscal year ending June 30, 1895	4,434.77
Amount (estimated) required for completion of existing project	22,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	15,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix J 4.)

5. *Nomini Creek, Virginia.*—This stream is an important tributary of the Potomac, which it enters about 82 miles below Washington, D. C.

Navigation was obstructed in 1872 by a bar of sand and oyster shells at its mouth, over which but 3 feet could be carried at low tide, and the dangers and difficulties of passing the bar were further increased by a rapid current and cross tides. After passing the bar 8 feet can be carried to Nomini Ferry, about 4 miles above the mouth.

The original project for the improvement, adopted in 1873, provided for dredging a channel 100 feet wide and 9 feet deep through the bar. The project was modified in 1879 by increasing the width to 150 feet, and again in 1885 by increasing the width to 200 feet. In 1890 a further modification was made, proposing the construction of two jetties parallel to the outer channel, retaining the width of dredging at 150 feet. The total cost of this modified project was placed at $72,500. At the close of work in 1883 a channel about 100 feet wide and 9 feet deep had been dredged through the bar. During the suspension of work from 1883 to 1889 the cut was reduced in depth and width by deposits of sand. In 1889 the outer channel was widened and redredged on the westerly side for a width of 94 feet and a length of 1,470 feet, the depths being from 8.9 to 13.8 feet.

During the fiscal year ending June 30, 1891, the channel at and outside of White Point was dredged, the width attained being from 130 to 150 feet, and the depth 9 feet. A riprap dike was built inside White Point to check the cross tidal currents.

No work was done during the fiscal year ending June 30, 1892.

Up to the close of the fiscal year ending June 30, 1893, $43,877.11 had been expended. Two hundred linear feet of the east jetty outside White Point was finished. During the fiscal year ending June 30, 1894, 265 linear feet of the east jetty has been completed, making a total of 465 linear feet.

July 1, 1893, balance unexpended	$8,622.89
June 30, 1894, amount expended during fiscal year	2,366.95
July 1, 1894, balance unexpended	6,255.94
July 1, 1894, amount covered by uncompleted contracts	5,978.00
July 1, 1894, balance available	277.94
Amount appropriated by act of August 17, 1894	5,000.00
Amount available for fiscal year ending June 30, 1895	5,277.94

Amount (estimated) required for completion of existing project	$15,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	15,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix J 5.)

6. *Lower Machodoc Creek, Virginia.*—Lower Machodoc Creek is a tributary of the Potomac River, which it enters on the right about 85 miles below Washington, D. C. It has a navigable length of about 4 miles, and the lower part of the stream affords a good harbor for vessels drawing 12 feet or less. In 1892 navigation was obstructed by a bar at the "Narrows" 2 miles above the mouth, over which but 4 feet could be carried at low tide. After passing the bar depths of from 10 to 14 feet are found, gradually diminishing, however, to about 6 feet at Drum Bay, the head of navigation.

The project for the improvement, based on the survey of 1892, made subsequent to the appropriation of July 13 of that year, provides for dredging a channel 9 feet deep and 150 feet wide through the bar at the "Narrows," at an estimated cost of $15,000.

The first appropriation for the improvement was made July 13, 1892, the amount being $3,000.

At the close of the fiscal year ending June 30, 1893, $227.65 had been expended. A survey of the bar had been made and dredging commenced.

During the fiscal year ending June 30, 1894, the dredging of the channel through Narrows Bar was continued as far as the available funds would permit, and a channel 6 feet deep and 150 feet wide secured through the bar.

July 1, 1893, balance unexpended	$2,772.35
June 30, 1894, amount expended during fiscal year	2,635.74
July 1, 1894, balance unexpended	136.61
Amount appropriated by act of August 17, 1894	3,000.00
Amount available for fiscal year ending June 30, 1895	3,136.61

Amount (estimated) required for completion of existing project	9,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	9,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix J 6.)

7. *Patuxent River, Maryland.*—The present head of navigation on the Patuxent River is Bristol, Md., about 46 miles above the mouth. Prior to the commencement of the improvement navigation below Bristol was obstructed by two mud bars; (1) Swann Point Bar, about 43 miles above the mouth, having a least depth of 7.8 feet, and (2) Bristol Bar, at Bristol, having least depths in front of the two wharves of 7.6 and 4.2 feet. Two other bars below, viz, Pope Shoal (24 miles above the mouth) and Warren Reach Bar (34 miles above the mouth), were mentioned in the report of the preliminary examination as worthy of survey, but they offer no obstruction to the present standard of navigation.

The original project was adopted in 1888, and contemplated dredging a cut 200 feet wide and from 12 to 13 feet deep through Swann Point Bar and Bristol Bar, so as to secure a permanent channel about 100 feet wide and 12 feet deep at low tide. This project was modified in 1890, so as to provide for a channel 120 feet wide and 12 feet deep (then already dredged) at Bristol Bar, and a channel 100 feet wide and 9 feet deep at Swann Point Bar; these last-named dimensionss being regarded as sufficient for the present and immediate prospective demands of commerce.

At the close of the fiscal year ending June 30, 1893, $10,114.13 had been expended. A channel, 120 feet wide 12 feet deep and 794 feet long, had been dredged at Bristol Bar, and a channel 9 feet deep, about 100 feet wide and about 2,250 feet long, through Swann Point Bar.

A survey of these two bars, made in June, 1894, shows that the present dimensions of channel are sufficient for the navigation of the river, and no further appropriations are recommended.

July 1, 1893, balance unexpended	$855.87
June 30, 1894, amount expended during fiscal year	473.17
July 1, 1894, balance unexpended	382.70

(See Appendix J 7.)

8. *Rappahannock River, Virginia.*—The obstructions to navigation of the Rappahannock River before improvement were nine bars between Tappahannock, 41 miles above the mouth, and Fredericksburg, 106 miles above the mouth, over which the ruling depths were from 4 to 10.5 feet. The chief obstructions were in the 12.5 miles of river below Fredericksburg, where seven of the bars are found. Of these bars, Fredericksburg Bar, with a least depth of 4 feet, and Spottswood Bar, 4 miles below Fredericksburg, with a least depth of 6 feet, caused the most delay to steamboats and vessels.

The original project adopted in 1871 proposed a channel 10 feet deep and 100 feet wide through all the bars. This was modified in 1879 by increasing the dimensions of the channel between Port Royal and Tappahannock to 15 feet in depth and 200 feet in width, to accommodate the larger class of vessels.

Up to June 30, 1893, $90,500 had been expended on the original project and $129,231.27 on the modified project, making a total of $219,731.27, and depths of from 8.4 to 9.5 feet secured through the bars between Fredericksburg and Port Royal by dredging and the construction of dikes. Wrecks and snags obstructing navigation had also been removed.

During the fiscal year ending June 30, 1894, $11,403.41 has been expended. The channel through Fredericksburg Bar, which was in progress on June 30, 1893, has been redredged as far as the available funds would permit. A channel 100 feet wide and 10 feet deep was dredged for a distance of 2,500 feet, while for a farther distance of 2,200 feet a width of 67 feet and a depth of 10 feet were secured. The material deposited behind the dikes at this bar has been protected by brush fences from erosion during freshets.

As each recurring freshet brings additional deposits of sand and silt into the river, the officer in charge recommends an annual appropriation of $7,500 for the maintenance of the improvement.

July 1, 1893, balance unexpended	$14,768.73
June 30, 1894, amount expended during fiscal year	11,403.41
July 1, 1894, balance unexpended	3,365.32
July 1, 1894, outstanding liabilities	*1,929.00
July 1, 1894, balance available	1,436.32
Amount appropriated by act of August 17, 1894	10,000.00
Amount available for fiscal year ending June 30, 1895	11,436.32

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* $1,916.97 due on contract with George E. Ward, dated April 5, 1889.

Amount (estimated) required for completion of existing project	$137,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	25,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix J 8.)

9. Urbana Creek, Virginia.—Urbana Creek is a tributary of the Rappahannock River, which it enters 16 miles above the mouth. Before improvement navigation was obstructed by a bar outside the mouth, over which but 6.5 feet could be carried, and a shoal within the creek having a least depth of 7 feet.

The original project, adopted in 1879, provided for dredging a channel 150 feet wide and 10 feet deep through the outer bar. This project was extended in 1883 so as to include dredging to 10 feet through a shoal within the creek near the town of Urbana.

Up to the close of the fiscal year ending June 30, 1893, $22,206.48 had been expended. The channel through the outer bar had been dredged to a depth of 10 feet and a width of 140 feet, but owing to the action of storms the width had decreased from sand filling to 110 and shoaled to depths of from 8½ to 9½ feet. It was therefore necessary to redredge the channel in order to maintain the standard of navigation. This work was in progress on June 30, 1893.

A channel had also been dredged through the shoal within the creek from 80 to 170 feet wide and 10 feet deep, and dikes and jetties had been built along the sand spit to check the movement of the sand, which tends to close the natural channel at the end of the spit. This channel was widened 70 feet by dredging off the end of the sand spit. The depth made was 10 feet at low tide.

During the fiscal year ending June 30, 1894, the redredging of the outer channel has been completed as far as the funds would permit, and a channel 10 feet deep and 120 feet wide has been secured through the bar.

July 1, 1893, balance unexpended	$2,293.52
June 30, 1894, amount expended during fiscal year	2,277.63
July 1, 1894, balance unexpended	15.89
Amount appropriated by act of August 17, 1894	3,000.00
Amount available for fiscal year ending June 30, 1895	3,015.89

Amount (estimated) required for completion of existing project	7,080.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	7,080.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix J 9.)

10. York River, Virginia.—The Pamunkey and Mattaponi rivers unite at West Point, Va., to form the York River, which is 41 miles in length and empties into Chesapeake Bay about 16 miles above Old Point, Va. Prior to the commencement of the improvement navigation was obstructed by Potopotank Bar, 9 miles below West Point, on which the ruling depth was 18.5 feet; by West Point Bar, extending about 2 miles below West Point, and having a ruling depth of 15.5 feet, and by shoal water in front of the West Point wharves, at the mouth of the Pamunkey.

The original project provided for a channel 22 feet deep and 200 feet wide through these bars, with an increased width at the wharves. In 1884 the proposed channel width was increased to 400 feet, and in 1887 the project was amended so as to include the construction of a dike along the flats on the right of the channel to contract the waterway and maintain the depth dredged, which had decreased from continued silting.

Up to the close of the fiscal year ending June 30, 1893, $148,277.60 had been expended in the following work: A channel 105 feet wide and 22 feet deep was dredged in 1880–'81 through Potopotank Bar, which had, however, shoaled in 1890 to 20.8 feet. A channel 22 feet deep and from 161 to 257 feet wide, with a center cut 24 feet deep and 40 feet wide, had been dredged at West Point Bar below the wharves, but this channel has shoaled to such an extent that much redredging has been necessary. The channel in front of the West Point wharves has been dredged to a width of 160 feet and a depth of 22 feet, the length being 2,700 feet. The construction of the dike at West Point Bar had been commenced.

During the fiscal year ending June 30, 1894, 7,639 linear feet of sheet-pile dike has been built at West Point Bar.

July 1, 1893, balance unexpended		$45,472.40
June 30, 1894, amount expended during fiscal year		35,822.88
July 1, 1894, balance unexpended		9,649.52
July 1, 1894, outstanding liabilities	$50.00	
July 1, 1894, amount covered by uncompleted contracts	5,330.42	
		5,380.42
July 1, 1894, balance available		4,269.10
Amount appropriated by act of August 17, 1894		20,000.00
Amount available for fiscal year ending June 30, 1895		24,269.10
Amount (estimated) required for completion of existing project		95,050.00
Amount that can be profitably expended in fiscal year ending June 30, 1896		95,050.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

(See Appendix J 10.)

11. *Mattaponi River, Virginia.*—The Mattaponi River is navigable for small steamers from its mouth, at West Point, Va., to Ayletts, Va., a distance of about 52 miles, and can be made navigable for barges for about 26 miles above Ayletts to Munday bridge. The obstructions to 5.5-foot navigation are five bars below Ayletts, having ruling depths of from 2.5 to 3.6 feet, and wrecks, snags, logs, and overhanging trees.

There were eight bars reported above Ayletts, but no improvement of them is proposed.

The approved project adopted in 1880 provides for a channel 40 feet wide and 5.5 feet deep through the bars below Ayletts and the removal of logs, snags, overhanging trees, wrecks, etc., as far up as Munday bridge. The river and harbor act of July 13, 1892, directed the expenditure of $1,500 in improvement of the river between Ayletts and Guinea bridge, near Milford Station, on the Richmond, Fredericksburg and Potomac Railroad.

Up to the close of the fiscal year ending June 30, 1893, $20,098.30 had been expended in removing snags, wrecks, logs, and other obstructions between Robinson Bar and Munday bridge, a distance of 34 miles, in building 2,226 linear feet of dike at Robinson Bar, and the construction of the plant necessary for these operations.

During the fiscal year ending June 30, 1894, the removal of snags was continued under the appropriation of $4,000 made July 13, 1892.

Owing to the shoal water found, only a small part of the work above Ayletts could be done.

July 1, 1893, balance unexpended	$3,201.70
June 30, 1894, amount expended during fiscal year	866.81
July 1, 1894, balance unexpended	2,334.89
Amount appropriated by act of August 17, 1894	4,000.00
Amount available for fiscal year ending June 30, 1895	6,334.89
Amount (estimated) required for completion of existing project	44,800.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix J 11.)

12. *Pamunkey River, Virginia.*—The Pamunkey River has a navigable length of 59 miles, and empties into the York River at West Point, Va. Navigation was originally obstructed by five bars in the upper part of the river, and by snags, logs, and overhanging trees.

The project was adopted in 1880 and amended in 1885, and provides for channels 100 feet wide and 7 feet deep through Spring Bar and Skidmore Bar, or to a distance of 47 miles above West Point, and channels 40 feet wide and from 3 to 5 feet deep through the bars above, together with the removal of logs, wrecks, snags, and overhanging trees.

The amount expended to June 30, 1893, was $18,500. Snags, logs, and overhanging trees had then several times been removed from 22.5 miles of the river between Garlick Ferry and Hanovertown; dikes had been built at Spring Bar and Skidmore Bar, and a channel 95 feet wide and from 6 to 7 feet deep had been dredged through Skidmore Bar. The plant necessary for snagging operations, pile-driving, etc., had been constructed, being paid for in part from appropriations for this river.

During the fiscal year ending June 30, 1894, snags, logs, and similar obstructions were again removed between White House and Hanovertown, a distance of 30 miles.

July 1, 1893, balance unexpended	$3,000.00
June 30, 1894, amount expended during fiscal year	381.02
July 1, 1894, balance unexpended	2,618.98
Amount appropriated by act of August 17, 1894	2,000.00
Amount available for fiscal year ending June 30, 1895	4,618.98
Amount (estimated) required for completion of existing project	5,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	5,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix J 12.)

13. *Removing sunken vessels or craft obstructing or endangering navigation.*—The wreck of the schooner *Samuel W. Thomas*, in St. Georges River, Maryland, was reported on October 4, 1893, as an obstruction to navigation. The usual notice of thirty days to persons interested was published and proposals for removing the wreck opened December 9, 1893. A contract for the work was entered into for the sum of $323, and the wreck successfully removed December 28–31, 1893. The total expenditure was $498.79.

The steamer *W. W. Coit* was burned in the Washington Channel of the Potomac River, November 5, 1893, and sank soon after, becoming a dangerous obstruction to navigation. After the usual notice of thirty days to parties interested, proposals were opened for removing the wreck on January 2, 1894. A contract for the work was entered into January 9, 1894, for the sum of $1,137, and the removal of the wreck was completed June 21, 1894. The total expenditure was $1,418.98.

(See Appendix J 13.)

IMPROVEMENT OF RIVERS AND HARBORS IN SOUTHEASTERN VIRGINIA AND NORTHEASTERN NORTH CAROLINA.

This district was in the charge of Capt. Edward Burr, Corps of Engineers; Division Engineer, Col. William P. Craighill, Corps of Engineers.

1. *Harbor of Norfolk and its approaches, Virginia.*—In 1877, previous to the commencement of the present improvement, the harbor of Norfolk was obstructed by shoals at the mouths of the Eastern and Southern branches, the shoal in the Eastern Branch being about one-third of a mile long, with a low-water depth of 15 to 16 feet, and the shoal in the Southern Branch being short and with a depth of 22 to 23 feet.

The approaches to the harbor were obstructed by shoals at Sewalls Point, 3 miles long, with a low-water depth of 20 feet, and at the mouth of the Western Branch 1 mile long, with a low-water depth of 19 feet. The depths on these shoals and the widths of the channels, particularly in the inner harbor where encroached upon by the Portsmouth and Berkley flats, were insufficent for the requirements of the port.

The plan of improvement adopted in 1878 was to deepen and widen the channels at the mouth of the Southern Branch and along Portsmouth and Berkley flats in the harbor proper, and to improve the approaches to the harbor by dredging a channel 500 feet wide and 25 feet deep at ordinary low water through the shoals at Sewalls Point and at the mouth of the Western Branch.

The revised project of 1885 is as follows: (1) To dredge a channel, not less than 500 feet wide and 25 feet deep at ordinary low water, from the deep water in Hampton Roads to Norfolk and the United States navy-yard on the Southern Branch, and also to dredge a channel in the Eastern Branch not less than 22 feet deep at ordinary low water, with a width of 700 feet at its mouth and of not less than 300 feet at the Norfolk and Western Railroad bridge; (2) to ultimately dredge the entire area bounded by lines parallel to and 75 feet from the port-warden lines to a depth not less than 25 feet from Fort Norfolk to the United States navy-yard and not less than 22 feet from the mouth of the Eastern Branch to Campostella bridge, and to build a bulkhead at Berkley flats.

To the project of 1885 there was added in 1890, the dredging of an anchorage at the mouth of the Western Branch, with a depth of not less than 25 feet at ordinary low water, at an estimated cost of $150,000, which amount was added to the original estimate.

With slight modifications all operations have been conducted in accordance with the adopted projects.

The amount expended on this improvement to June 30, 1893, was $743,611.07, from which resulted a channel, not less than 500 feet wide and 25 feet deep at ordinary low water, from Hampton Roads to Norfolk Harbor, a channel of the same depth and from 400 feet to 650 feet wide in the Southern Branch to the United States navy-yard, and a channel not less than 22 feet deep at ordinary low water and from 500 feet to 1,050 feet wide in the Eastern Branch to the Norfolk and Western Railroad bridge.

The channels thus dredged were in good condition, with the exception of the bars at Sewalls Point and Lambert Point. Examinations made in August, 1893, show shoal spots having from 23½ to 24 feet on the former, and considerable shoaling on the eastern side of the dredged channel through the latter.

One hundred and fifty thousand dollars was appropriated for this improvement by act of July 13, 1892, and a contract was made with the Morris and Cumings Dredging Company of New York, N. Y., to remove about 1,000,000 cubic yards of material, the contract to be completed by December 31, 1893.

Dredging was commenced under this contract in November, 1892, and by June 30, 1893, 917,170 cubic yards of material had been removed and redeposited on Willoughby Bank, to the eastward of the Ripraps, in Hampton Roads. During the past fiscal year 56,131 cubic yards of material were excavated from the anchorage at the mouth of the Western Branch. The contract was completed July 31, 1893, the total amount of material excavated being 973,301 cubic yards.

The dredging at the mouth of the Western Branch added 2.5 acres to the proposed anchorage, with a depth of not less than 25 feet at ordinary low water, excepting over a number of old wrecks that were uncovered by the dredging and have not yet been removed. As the result of the past operations, 58.5 acres of the proposed anchorage had been dredged and 17 acres requiring no dredging has been made available.

The expenditures during the fiscal year amounted to $38,416.74, and were applied to payments on contract, repairs to plant, office, and operating expenses, etc.

July 1, 1893, balance unexpended	$41,456.43
June 30, 1894, amount expended during fiscal year	38,416.74
July 1, 1894, balance unexpended	3,039.69
Amount appropriated by act of August 17, 1894	100,000.00
Amount available for fiscal year ending June 30, 1895	103,039.69
Amount (estimated) required for completion of existing project	156,744.56
Amount that can be profitably expended in fiscal year ending June 30, 1896	156,744.56
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix K 1.)

2. *Approach to Norfolk Harbor and the United States (Norfolk) navy-yard between Lambert Point and Fort Norfolk.*—In its original condition this portion of the approach to Norfolk Harbor was obstructed by a shoal at the mouth of the Western Branch, about 1 mile long, with a depth of 19 feet at ordinary low water.

The project of 1878 was to dredge through this shoal a channel 500 feet wide, with a depth of not less than 25 feet at ordinary low water.

The revised project of 1886 is (1) to secure a channel not less than 500 feet wide and 25 feet deep at ordinary low water from Lambert Point to Fort Norfolk by the construction of a dike, and by dredging, and (2) to ultimately widen this channel to within 75 feet of a straight line drawn from Fort Norfolk to the deep water off Lambert Point, 6,800 feet of which is the proposed port-warden line, making the channel at least 700 feet wide.

The amount expended on this improvement between July 5, 1884, and June 30, 1893, was $197,593.75, from which resulted a channel between Lambert Point and Fort Norfolk 700 feet wide and 25 feet deep at ordinary low water, and a channel of the same depth and 600 feet wide from deep water off Lambert Point to the port-warden line.

There were no expenditures during the fiscal year ending June 30, 1894, for this improvement.

The project of 1886 has been completed with the exception of the dike. The survey of 1889 and examinations of April, 1890, and May, 1891, did not show any shoaling of the dredged channel. A survey made in May, 1892, showed a shoaling on the eastern side of the channel, thought not to be due to natural causes, and a resurvey in August, 1892, shows a further shoaling, and partially confirms this view. It is not thought that the proposed dike will be necessary for the maintenance of this channel. To maintain the projected depth, redredging of a portion of the channel will soon be necessary, but it can be provided for out of the funds for improving harbor at Norfolk and its approaches, Virginia, and no further appropriation will be required for this project at present.

(See Appendix K 2.)

3. *Nansemond River, Virginia.*—This river is one of the important tributaries of Hampton Roads, Virginia, and is navigable at high water for vessels drawing 11 feet as far as the city of Suffolk, 16 miles from its mouth.

Five railroads, two of which terminate at this place, put this city in communication with the South and West, and two lines of steamers run between it and Norfolk and Baltimore.

In 1872, before any improvement was undertaken, the navigable channel of the Nansemond River was 5 feet deep at low water, and was much obstructed by wrecks, snags, etc.

Between 1873 and 1878 the Government dredged the channel, wherever necessary, 8 feet deep at low water, from Suffolk to Hampton Roads, at a cost of $37 000. This depth not being sufficient to meet the demands of its growing commerce, in obedience to the requirements of the river and harbor act of August 5, 1886, an examination and survey of the river were made to determine what other improvement was necessary.

The plan of improvement then proposed and since adopted is to secure a channel not less than 100 feet wide at bottom, 12 feet deep at mean low water, from the head of navigation to the mouth of the Western Branch, 5.37 miles, including a turning basin 200 feet square, 300 feet below Suffolk bridge, by dredging and by the construction of spurs and training walls; and a channel of like depth from the mouth of the Western Branch to deep water at Town Point, 200 feet wide at bottom at its upper end, and gradually increasing to at least 400 feet at its lower end, etc., the total estimated cost being, in round numbers, $152,500.

The amount expended in the present project to June 30, 1893, was $29,968.72, which was applied to dredging a channel 80 feet wide and 12 feet deep, at ordinary low water, through Suffolk Shoal and five other shoals between Suffolk and a point 3½ miles below. A survey made in September, 1893, shows the dredged channel to be, generally, in good condition. It also shows other shoals requiring dredging before the construction of the works of permanent improvement can be commenced.

The amount expended during the fiscal year was $25.50, and was applied to surveys, office, and incidental expenses, etc

July 1, 1893, balance unexpended	$31.28
June 30, 1894, amount expended during fiscal year	25.50
July 1, 1894, balance unexpended	5.78
Amount appropriated by act of August 17, 1894	10,000.00
Amount available for fiscal year ending June 30, 1895	10,005.78

Amount (estimated) required for completion of existing project	$112, 500. 00
Amount that can be profitably expended in fiscal year ending June 30, 1896	50, 000. 00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix K 3.)

4. *Chickahominy River, Virginia.*—This river is one of the principal tributaries of the James River, and is navigable at high water for vessels drawing 12 feet to Binn Bar, 2½ miles below Windsor Shades. The latter place is the head of navigation, and is 25 miles from the mouth of the river.

Previous to any improvement, the channel from Binn Bar to Windsor Shades was obstructed by several shoals, with a depth of 4 to 5 feet at low water, and the entrance to the river was obstructed by a bar.

The present project of improvement is to dredge a channel from 100 to 150 feet wide, and not less than 8 feet deep at low water, through the shoals near the head of navigation, and a channel 200 feet wide and 14 to 15 feet deep at low water, through the bar at the entrance. The rise of the tide is about 3 feet.

The amount expended on the present project to June 30, 1893, was $23,827.71. The channel through the bar at the entrance to the river has been dredged to the projected dimensions. The channel through the shoals between Binn Bar and Windsor Shades has been dredged to not less than 8 feet deep at low water, and to a width of 60 feet, excepting a part of Windsor Shades Bar, where the width is 40 feet.

Five thousand dollars was appropriated for this improvement by act of July 13, 1892, and a contract was made with Chester T. Caler, of Norfolk, Va., to do the required dredging, the work to be completed by April 30, 1894. The contractor failed to begin work before the expiration of the time named and, upon his application, an extension of sixty days of the time of completion was granted him. Work was begun June 9, 1894, and the contract had not been completed at the end of the fiscal year.

Seventeen thousand four hundred and forty-six cubic yards of material was removed, and redeposited by dumping from scows, in accordance with the terms of his contract, resulting in an increase of the width of the channel at Windsor Shades Bar to 100 feet, with a depth of 8 feet at ordinary low water.

The funds available for the present contract will practically complete the present project, and furnish all the facilities necessary for the transportation interests on this stream. No further appropriations are necessary.

The amount expended during the fiscal year was $2.20.

July 1, 1893, balance unexpended		$5, 172. 29
June 30, 1894, amount expended during fiscal year		2. 20
July 1, 1894, balance unexpended		5, 170. 09
July 1, 1894, outstanding liabilities	$2, 267. 98	
July 1, 1894, amount covered by uncompleted contracts	2, 432. 02	
		4, 700. 00
July 1, 1894, balance available		470. 09

(See Appendix K 4.)

5. *Appomattox River, Virginia.*—This river is one of the principal tributaries of the James River, into which it empties at City Point, Va. It is navigable as far as the city of Petersburg, about 11 miles from its mouth, and before improvement had a tortuous channel, obstructed by shoals, over which there was about 6½ feet of water at high tide.

The project for this improvement was adopted in 1870, and provided for a channel 60 feet wide at bottom, and 12 feet deep at ordinary high water. As subsequently modified, the project is to provide a channel from Petersburg to natural deep water at Point of Rocks, 80 feet wide at the bottom and 12 feet deep at ordinary high water, by dredging, by constructing regulating and contracting works, and by making a cut-off called Puddledock Cut. With slight modifications of details all operations have been conducted in accordance with this project.

This stream is subject irregularly to freshets, by which large quantities of sand are brought down and deposited in the navigable portion of the river. The currents of ordinary stages of the river have not sufficient power to remove the shoals thus formed, and the sum of $10,000 per annum is estimated as required for their removal by dredging, and for repairing damages to contracting and regulating works by freshets and deterioration. The sums appropriated for this improvement have for many years been but little in excess of the amount required for the repairs to the channel and the works already constructed. The completion of the permanent improvement of the river has consequently dragged beyond all reason, and the apparent cost of the improvement has been much in excess of the original estimates, while the actual amount expended in accordance with these estimates has been but a small proportion of the total expenditures.

The amount expended by the United States on this improvement to June 30, 1893, was $416,643.63.

By 1875 a channel, 60 feet wide and 12 feet deep at ordinary high water, had been secured from Petersburg to Point of Rocks, by dredging such shoals as required it, and by making a cut-off called Puddledock Cut. This channel was subsequently increased in width to 80 feet, and has been maintained with a depth of 11 to 12 feet as constantly as possible by redredging shoals formed by freshets and by constructing contracting and regulating works.

The redredging of shoals formed by the winter and spring freshets was begun in April, 1894. The dredged channels on the shoal on Magazine Bend and in the South Channel, below Gatlings Landing, have been obliterated. The shoal at the Closure Dike shows encouraging signs of improvement, due to the action of the low dam constructed behind the dike, and it is hoped that, after the channel is well opened, no further great amount of dredging will be necessary on this shoal in the future.

The total amount dredged during the year was 17,150 cubic yards, of which 4,900 cubic yards was removed from Magazine Bend, 1,950 cubic yards from the shoal at the Closure Dike, and 10,300 cubic yards from the shoal below the mouth of the South Channel. The material from Magazine Bend and the Closure Dike was placed behind the Closure Dike dam to strengthen it.

The dredging was done by hired labor, the use of the Government plant, and the hire of the dredge belonging to the city of Petersburg. The average cost was 18 cents per cubic yard.

The amount expended during the fiscal year, $5,278.31, was applied to the above work, to office and incidental expenses, the care and repair of plant, etc.

July 1, 1893, balance unexpended	$7,280.87
June 30, 1894, amount expended during fiscal year	5,278.31
July 1, 1894, balance unexpended	2,002.56
July 1, 1894, outstanding liabilities	480.00
July 1, 1894, balance available	1,522.56
Amount appropriated by act of August 17, 1894	5,000.00
Amount available for fiscal year ending June 30, 1895	6,522.56

Amount (estimated) required for the completion of existing project....	$48, 090. 00
For maintenance and repairs for fiscal year ending June 30, 1896......	10, 000. 00
Amount that can be profitably expended in fiscal year ending June 30, 1896	58, 090. 00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

(See Appendix K 5.)

6. *Inland water route from Norfolk, Va., to Albemarle Sound, North Carolina, through Currituck Sound.*—This is one of the most important links in the chain of inland water communication along the Atlantic coast.

It connects Chesapeake Bay with Albemarle Sound, and is composed of the following bodies of water: Elizabeth River, North Landing River, Currituck Sound, Coanjok Bay, North River, and the Albemarle and Chesapeake Canal. With the exception of the canal, which was constructed and is maintained by private enterprise, all are natural waterways.

Before any improvement was undertaken by the Government there was over this route an indifferent channel 5 to 7 feet deep at low water, the navigation of which was obstructed by overhanging growth, snags, and sharp bends in all the rivers.

The project adopted was to secure a channel 80 feet wide and 9 feet deep at low water over the entire route, about 58 miles, by dredging, by removing obstructions, and by constructing a dike.

Steady progress has been made toward securing this result, and at present the regular steamboat lines running between North Carolina ports and Norfolk and Baltimore employ vessels whose maximum dimensions are: Length, 190 feet; width, 25.2 feet; draft, 8 feet, and tonnage, 421 tons.

In the river and harbor acts before that of September 19, 1890, three separate items were inserted for this improvement; in that of September 19, 1890, and in subsequent acts, one item was made to cover the entire route.

Since the appropriation of September 19, 1890, $9,300.23 had been expended on this improvement to June 30, 1892.

Nine thousand dollars was appropriated for this improvement by act of July 13, 1892, and a contract was made with Chester T. Caler, of Norfolk, Va., to do the required dredging, the work to be completed by April 30, 1894. Dredging on North River, North Carolina, was commenced under this contract on February 28, 1894, and completed April 16, 1894. Thirty-nine thousand two hundred and seventy-six cubic yards of material and 34 saw logs were removed and redeposited in accordance with the contract. A channel 80 feet wide and 9 feet deep at low water and 5,150 feet long was dredged from the southern end of the North Carolina cut of the Albemarle and Chesapeake Canal to a point southward 2,000 feet from Beacon No. 9.

Twenty-five thousand seven hundred and twenty-four cubic yards was dredged in deepening the channel in Currituck Sound, between Beacons No. 5 and No. 6. A channel 70 feet wide and 9 feet deep at low water was dredged for a length of 4,300 feet, beginning at Beacon No. 6.

The total amount dredged during the year was 65,000 cubic yards.

The amount expended during the fiscal year was $9,623.23, and was applied to payments on contract, office, and incidental expenses, etc.

July 1, 1893, balance unexpended..........	$9, 699. 74
June 30, 1894, amount expended during fiscal year..........	9, 623. 23
July 1, 1894, balance unexpended..........	76. 51
Amount appropriated by act of August 17, 1894..........	10, 000. 00
Amount available for fiscal year ending June 30, 1895..........	10, 076. 51

Amount (estimated) required for completion of existing project	$39,667.08
Amount that can be profitably expended in fiscal year ending June 30, 1896	39 667.08

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

(See Appendix K 6.)

7. *North Landing River, Virginia and North Carolina.*—This river forms a part of the "Inland water route from Norfolk Harbor to Albemarle Sound," described above.

Before improvement the navigation of this river was obstructed by shoals over which the depth was 6 feet at low water, by snags, and by sharp bends.

The plan of improvement, adopted in 1879, was to secure a channel 80 feet wide and 9 feet deep at low water by dredging shoals and removing bends and obstructions.

This project was completed June 30, 1884, at a cost of $49,777.34, and the desired channel obtained over a distance of 17 miles. Since that time $6,379.54 has been expended on this river in removing sunken logs which have become detached from passing rafts, making a total expenditure on this improvement to June 30, 1893, of $56,156.88.

The river was last cleared of sunken logs in August and September, 1892, these obstructions having by that time become troublesome to navigation.

The method adopted for rafting logs in these waters is very faulty, resulting in a considerable loss of logs to the owners and the material obstruction to navigation on this river and the connecting portions of the "Inland water route," by decreasing the available navigable depth by at least 1 foot, and by remaining a menace to the hulls and propellers of passing vessels.

These sunken logs are now the controlling element of the available depth in these streams, and the desirability of doing any further dredging while the rafting business is carried on under the present system is questionable.

There were no expenditures during the fiscal year. There is still a small balance available for the continuance of operations, and no further appropriation for this work is necessary.

July 1, 1893, balance unexpended	$1,512.81
July 1, 1894, balance unexpended	1,512.81

(See Appendix K 7.)

8. *Removing sunken vessels or craft obstructing or endangering navigation.—Wrecks of the schooners Lulu, Edith Berwind, and Mary E. H. G. Dow.*—The three-masted wooden schooner *Lulu*, loaded with coal, went ashore on the Horseshoe, Chesapeake Bay, and became a wreck. The four-masted wooden schooners *Edith Berwind* and *Mary E. H. G. Dow*, loaded, respectively, with phosphate rock and with coal, went ashore on the Nautilus Shoal and the Outer Middle Ground, respectively, Cape Charles, Virginia, and became wrecks. They were allowed by their owners to remain as obstructions to navigation for periods longer than two months, and, it having become apparent that their owners did not propose to remove them, the thirty days' notice required by law was published and specifications for their removal were issued.

A contract was entered into on June 19, 1893, with W. H. French, of Norfolk, Va., for their removal, at a cost of $1,500 for the *Lulu*, $1,700 for the *Edith Berwind*, and $1,800 for the *Mary E. H. G. Dow*, the work to be commenced by July 1, 1893, and completed by August 31, 1893.

Operations were commenced under this contract on July 3, 1893, and completed August 1, 1893.

The total cost of the removal of the three wrecks was $5,181.92.

(See Appendix K 8.)

IMPROVEMENT OF CERTAIN RIVERS AND HARBORS IN VIRGINIA, NORTH CAROLINA, AND SOUTH CAROLINA.

This district was in the charge of Maj. W. S. Stanton, Corps of Engineers, with Lieut. E. W. Van C. Lucas, Corps of Engineers, under his immediate orders; Division Engineer, Col. William P. Craighill, Corps of Engineers.

1. *Roanoke River, North Carolina.*—When the United States commenced this improvement, in 1872, navigation by vessels of 10 feet draft was embarrassed by the wreck of a gunboat 6 miles above the mouth of the river and by war obstructions at two other points 9 and 13 miles above its mouth. The river was also somewhat obstructed for that draft by snags in the channel and by leaning trees 67 miles to Indian Highland Bar; thence 62 miles up to Weldon its channel depth on the bars was not less than about 5 feet during about eight months annually, affording a continuous low-water navigation of not more than 2 or 3 feet, and its channel was badly obstructed by snags, logs, stumps, and leaning and overhanging trees.

The original project of 1872 is to secure at all seasons of the year an unobstructed channel with a least width of 50 feet from the mouth 129 miles to Weldon, with a low-water depth of 5 feet from Hamilton 67 miles to Weldon, and to clear the natural channel of snags and artificial obstructions from the mouth 62 miles to Hamilton to the depth requisite for vessels navigating the North Carolina sounds, which draw not more than 8 feet, by removing the war obstructions, snags, fallen and overhanging trees, sand bars, and ledges by dredging; the construction of training dikes, and blasting, at an estimated cost, at the high prices of that time, of $269,000.

To June 30, 1893, $144,471.97 had been expended upon the improvement.

At that date the natural channel depth was not less than 10 feet from the mouth 67 miles to Indian Highland Bar at extreme low water, and was, at ordinary low water, not less than 5 feet thence 62 miles to Weldon, except upon sand bars 150 feet long at Spring Gut 21 miles above Hamilton, about 1,600 feet long at Halifax 57 miles above Hamilton, and about 800 feet long 1¼ miles below Weldon, and upon a ledge of rock about 2,800 feet in length, extending from old Weldon Ferry up to old Weldon Landing, the depth at these four localities being about 4 feet at ordinary low water, assumed at the zero of the Weldon gauge.

From a point about 8 miles below Hamilton at intervals down about 21 miles to Cades Eddy, 33 miles above the mouth, the removal of snags from the channel and the clearing of the banks at bends was requisite, and between a point 7 miles above Hamilton and a point 43 miles above it, the trimming of about 12½ miles of single bank was needful; otherwise the river was in good navigable condition.

With the amount applied during the fiscal year ending June 30, 1894, 40½ miles of channel extending from a point 12½ miles to a point 52 miles above the mouth, and 11 miles of channel extending from a point 119 miles above the mouth down to a point 108 miles above the mouth, have been cleared of snags; also 17.7 miles of single bank interspersed along 34 miles from a point 52 miles above the mouth of the river have been cleared of obstructions.

July 1, 1893, balance unexpended		$44, 829. 14
June 30, 1894, amount expended during fiscal year		13, 774. 14
July 1, 1894, balance unexpended		31, 055. 00
July 1, 1894, outstanding liabilities	$398. 18	
July 1, 1894, amount covered by uncompleted contracts	5, 000. 00	
		5, 398. 18
July 1, 1894, balance available		25, 656. 82
Amount appropriated by act of August 17, 1894		30, 000. 00
Amount available for fiscal year ending June 30, 1895		55, 656. 82

(See Appendix L 1.)

2. *Pasquotank River, North Carolina.*—When the United States began this improvement, in 1891, the river had a wide channel, nowhere less than 9½ feet deep in calm weather and 8 feet in northerly winds, from Albemarle Sound up 17 miles to Elizabeth City, and a narrower but good channel, but little obstructed, not less than 7 feet deep 13 miles farther up, to the entrance to the Dismal Swamp Canal at the lower end of Turners Cut; thence about 5 miles to the original terminus of the canal and upper end of Turners Cut in a tributary, the Moccasin Track, 1,100 feet above its confluence with the river, the natural depth was not less than 5 feet, the channel very sinuous, and badly choked with snags and stumps, and obstructed by overhanging trees, and above the Moccasin Track the river was likewise choked and obstructed.

The original project of 1889 was first to clear the 5 miles of channel in the river and Moccasin Track from the lower end of Turners Cut to the original terminus of the canal to permit boats passing through the canal to avoid Turners Cut, which had shoaled; and, second, to clear out the river 6 miles farther to Lebanon bridge, for navigation by pole or flat boats, at an estimated cost of $9,000.

By letter of August 3, 1892, the Chief of Engineers authorized the application of $3,000, appropriated by act of July 13, 1892, to be restricted to the removal of such obstructions from the channel below the lower mouth of Turners Cut as interfere with boats of the draft, about 3 feet, that can be carried through the canal, because as great a draft can be carried through Turners Cut, because boats traversing the canal continued to use Turners Cut in preference to the sinuous and longer route in the river and Moccasin Track, where a practicable channel had been cleared for them in 1891, and because of the very little commerce, merely by flat or pole boats, in the river above.

The sum of $4,497.17 had been expended to June 30, 1893.

At that date, for boats of the draft that can navigate the canal, the river channel was unobstructed up to the entrance of the canal at the lower mouth of Turners Cut.

No work has been done upon the river during the fiscal year ending June 30, 1894.

July 1, 1893, balance unexpended	$1, 508. 83
June 30, 1894, amount expended during fiscal year	9. 98
July 1, 1894, balance unexpended	1, 498. 85
July 1, 1894, outstanding liabilities	57. 50
July 1, 1894, balance available	1, 441. 35
Amount appropriated by act of August 17, 1894	1, 000. 00
Amount available for fiscal year ending June 30, 1895	2, 441. 35

(See Appendix L 2.)

3. *Mackeys Creek, North Carolina.*—When the United States began to improve it in 1892 the depth was only 7 feet in the somewhat circuitous channel on the shoal at the mouth of the creek in Albemarle Sound.

The project of 1889 was to dredge a straight channel 9 feet deep, 100 feet wide, and about 2,100 feet long through the shoal, modified in May, 1892, by increasing the width of the channel to 140 feet.

To June 30, 1893, $14,501.04 had been expended upon this improvement, and a channel 2,200 feet long, 140 feet wide, and 9 feet deep had been dredged through the shoal in completion of the project.

No money has been expended for its maintenance during the fiscal year ending June 30, 1894.

July 1, 1893, balance unexpended	$603.55
June 30, 1894, amount expended during fiscal year	139.06
July 1, 1894, balance unexpended	464.49
July 1, 1894, outstanding liabilities	50.00
July 1, 1894, balance available	414.49

(See Appendix L 3.)

4. *Ocracoke Inlet, North Carolina.*—In 1828, when the United States began to improve the inlet, vessels drawing 9 feet could cross the ocean bar and enter the inlet at low water; but the channel through the shoals immediately within the inlet into Pamlico Sound was not practicable for vessels drawing more than 5 feet.

In 1837 the sum of $133,732.40 was expended, producing an increase of 3½ feet in the depth of one of the channels to Pamlico Sound and "a material increase in the number of vessels seeking this outlet from North Carolina ports to the sea," but the shoaling of the dredged channel and destruction of a jetty constructed to prevent it led to the abandonment of the improvement.

In 1891, when the inlet was surveyed preparatory to resuming its improvement with the sum of $90,000 appropriated by the act of September 19, 1890, the depth in the channel on the bar was not less than 14 feet at low water and on the inner shoals was 7 feet in the channel then navigated and 5 feet in the channel selected for improvement.

The project of 1889 was to dredge a channel 300 feet wide and about 6,000 feet long through the inner shoals, at an estimated cost, if 10 feet deep, of $100,000; if 13 feet deep, of $190,000; and if 15 feet deep, of $280,000, with the possible construction of necessary protecting dikes at an additional cost of $320,000, aggregating $600,000.

To June 30, 1893, $5,128.15 had been expended.

At that date the channel to be improved on the inner shoals had been surveyed but no dredging had been done, and the depth on the ocean bar had diminished to 12 feet at mean low water.

With the amount expended during the fiscal year ending June 30, 1894, a careful supplemental survey of the inner shoals and an extensive series of current and tidal observations in their several channels have been made and completed and final detailed report thereon submitted.

In July, 1894, a modification of the project for this work was approved, and provides for improving Wallace Channel by dredging to a depth of 9 feet on Royal Shoal to obtain a channel with a bottom width of 300 feet and to a depth of 9 feet at Beacon Island Slue, at an estimated cost of $51,513.39.

July 1, 1893, balance unexpended	$99,876.85
June 30, 1894, amount expended during fiscal year	4,864.58
July 1, 1894, balance unexpended	95,012.27
July 1, 1894, outstanding liabilities	32.68
July 1, 1894, balance available	94,979.59

(See Appendix L 4.)

5. *Fishing Creek, North Carolina.*—From its confluence with the Tar River, 56 miles above Pamlico Sound, for about 50 miles up to Bellamys Mill, Fishing Creek averages about 75 to 100 feet wide, and has a channel of good practicable width for small steamboats. September 19, 1890, when the first appropriation was made for its improvement, the controlling channel depth on its bars was 3 feet at the average high-water stage of winter and spring. From its mouth about 17 miles to Savages bridge the channel was more or less obstructed by submerged snags; for the lower and greater part of the 25 miles thence to the vicinity of the Wilmington and Weldon Railroad bridge it was obstructed by many submerged snags and by large masses of trees and logs, forming in many places dense barricades spanning the creek and making its descent slow and tedious in a skiff.

From the railroad bridge about 8 miles up to Bellamys Mill the channel was impracticable on account of its sinuous character around a short ledge of rock, masses of rock projecting from the concave bank at six sharp bends, many leaning trees, and more or less submerged snags. In summer the channel depth is but a few inches.

The project of 1889 is "to clear out its natural obstructions from its mouth up to Bellamys Mill at a total expense of about $25,000."

No money has been expended upon its improvement to June 30, 1894, as the benefit to navigation resulting from improvement of the creek would be very restricted and not commensurate with the cost, and the subject was reported to Congress, on pages 1377 to 1380 of the Annual Report of Chief of Engineers for 1893, for its further instructions, which are still awaited.

July 1, 1893, balance unexpended	$15,000.00
July 1, 1894, balance unexpended	15,000.00
Amount (estimated) required for completion of existing project	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix L 5.)

6. *Pamlico and Tar rivers, North Carolina.*—(One river, called the Pamlico below and the Tar above Washington).—When the United States began to improve it, in 1877, its channel was obstructed in two places below Washington by piles; just below Sparta by scuttled lighters; 1 mile below Tarboro by the wreck of a steamer; immediately below Washington by a bar with a depth of 5 feet at low water on its crest in the channel; between Washington and Tarboro the available depth exceeded 2 to 3 feet not more than eight months annually, and above Washington the entire river was more or less obstructed by snags, logs, and stumps in its channel and by trees overhanging from its banks.

The project is that adopted in 1875 to secure by dredging and removal of war obstructions a clear and safe channel 9 feet deep at low water up to Washington, extended in 1879 to clear a channel 60 feet wide, 3 feet deep at low water 22 miles farther to Greenville, and 20 inches deep at low water 26 miles farther to Tarboro; again extended in 1889 to clear the river to its natural dimensions 40 miles farther to Little Falls, 2 miles below Rocky Mount, by removal of war obstructions, snags, logs, stumps, and overhanging trees, at a total final cost estimated in 1891 at $137,200.

To June 30, 1893, $84,926.56 had been expended upon this work.

At that date vessels could carry 7½ feet of water at all seasons up the Pamlico 39 miles to Washington, whence 22 miles to Greenville there was a channel 3 feet deep at low water, but only 35 feet in width at Red Banks Shoal, 2 miles below Greenville, which considerably curtailed the time annually during which steamboats could ascend to Greenville. From Greenville 26 miles to Tarboro the channel depth at low water was not less than 20 inches as prescribed in the project. The channel about 1 mile below Washington was obstructed by stumps found with frequency for about 1,100 feet and with infrequency for an additional 650 feet. Between Washington and Tarboro there were scattering snags in the channel.

Although the channel from Tarboro up 40 miles to Little Falls had been cleared of snags and trees, only one small boat ran a distance of 3 miles above Tarboro.

With the amount applied during the fiscal year ending June 30, 1894, of the 1,100 feet most obstructed by stumps below Washington, 500 linear feet has been cleared and 653 linear feet of dike built on the shoal at Red Banks, which has so improved it that it has ceased to be an obstruction, and there is now, from Washington 48 miles to Tarboro, a channel of the dimensions prescribed in the project.

July 1, 1893, balance unexpended	$3,566.41
June 30, 1894, amount expended during fiscal year	2,922.20
July 1, 1894, balance unexpended	644.21
July 1, 1894, outstanding liabilities	119.04
July 1, 1894, balance available	525.17
Amount appropriated by act of August 17, 1894	10,000.00
Amount available for fiscal year ending June 30, 1895	10,525.17
Amount (estimated) required for completion of existing project	39,200.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	10,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

(See Appendix L 6.)

7. *Contentnia Creek, North Carolina.*—When the United States began to improve it, in 1881, it was badly choked with fallen timber, snags, logs, and stumps; also obstructed by sand bars, and navigation rendered exceedingly difficult, in many places next to impossible, by the dense overhanging growth.

The project of 1881 is, by clearing it of these obstructions, to obtain, from its confluence with the Neuse 63 miles to Stantonsburg, a depth of not less than 3 feet during the higher stages of about 9 months' duration annually, at a cost estimated, in 1888, at $77,500.

To June 30, 1893, $56,614.41 had been expended upon this work.

At that date the reclearing of the channel from the mouth 31 miles up to Snow Hill was in progress and had been nearly completed, and the channel had been, in 1888, roughly cleared from Snow Hill up 32 miles to Stantonsburg, but above Snow Hill had not been navigated even by a pole boat.

With the amount applied during the fiscal year ending June 30, 1894, the clearing of the channel from Snow Hill to the mouth of the creek of snags, logs, stumps, and overhanging obstructions had been completed, and by the building of dikes the depth of the channel at Spring Slough, 1 mile above the mouth, increased about 6 inches.

July 1, 1893, balance unexpended	$3,495.23
June 30, 1894, amount expended during fiscal year	2,809.37
July 1, 1894, balance unexpended	685.86
July 1, 1894, outstanding liabilities	4.30
July 1, 1894, balance available	681.56
Amount appropriated by act of August 17, 1894	10,000.00
Amount available for fiscal year ending June 30, 1895	10,681.56

Amount (estimated) required for completion of existing project	8,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	7,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix L 7.)

8. *Trent River, North Carolina.*—When the United States began to improve it, in 1879, the river was comparatively free from obstructions from Newbern 18 miles to Pollocksville, between which points a draft of 6 feet could be carried at low water. Above Pollocksville it was obstructed by bars of sand and rock, and especially by great numbers of snags in the 11 miles from Lower Quaker bridge up to Trenton. One steamer ran regularly to Pollocksville, and one occasionally 9 miles farther to Lower Quaker bridge, above which point navigation was confined to flatboats and rafts.

The project of 1879 was to secure a channel 3 feet deep at low summer stage from Pollocksville to Trenton by removing all obstructions and dredging a cut 50 feet wide through the shoals at a cost estimated, in 1887, at $59,000.

In 1889 the project was extended to remove obstructions to permit navigation by small steamboats 33 miles above Trenton, and by pole boats 6½ miles farther to Upper Quaker bridge, at an additional cost of $13,000, the two projects aggregating $72,000.

To June 30, 1893, $55,763.02 had been expended upon this work.

At that date about 2,000 feet of channel within the mile and a quarter next below Trenton which had been dredged to 3 feet had shoaled to a depth of only about 18 inches, and at ten bends in the 11 miles next below Trenton the dredged channel had narrowed by shoaling so as to hamper boats in turning, and the turning basin at Trenton, which had been dredged to 6 feet, had shoaled so as to greatly reduce its depth and area. Between Newbern and Trenton snags had again accumulated in the channel, considerably impeding navigation.

With the amount applied during the fiscal year ending June 30, 1894, a channel, aggregating 2,085 feet in length, has been redredged through the shoals immediately below Trenton, increasing the depth 16 inches, so that the single boat running on the river can ascend to Trenton with the loss of, at most, only a very few trips annually; the turning basin at Trenton has been redredged to the depth of 1 to 3 feet, and the channel from Newbern to Trenton thoroughly cleared of snags, logs, stumps, and overhanging obstructions.

July 1, 1893, balance unexpended	$5,162.22
June 30, 1894, amount expended during fiscal year	4,449.48
July 1, 1894, balance unexpended	712.74
July 1, 1894, outstanding liabilities	268.37
July 1, 1894, balance available	444.37
Amount appropriated by act of August 17, 1894	4,000.00
Amount available for fiscal year ending June 30, 1895	4,444.37

Amount (estimated) required for completion of existing project	$7,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	7,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix L 8.)

9. Neuse River, North Carolina.—When the United States began to improve it in 1878, the minimum channel depth during nine months annually was 9 feet from the mouth 40 miles up to Newbern, 4 feet thence 50 miles to Kinston, 3 feet 46 miles farther to Goldsboro, and 2 feet thence 53 miles to Smithfield. Between Newbern and Kinston there were long stretches of shoals, upon at least one of which the depth at the low-water season was only about 18 inches. The channel was obstructed at two points below Newbern, and at two between Newbern and Kinston, by inclined iron-pointed spars and boxes or vessels or cribs filled with stones. From Contentnia Creek up 119 miles to Smithfield the river was badly obstructed by overhanging trees and by dense masses of logs and snags in the channel.

The project of 1871, as modified or extended in 1878, 1879, 1880, and 1883, was to remove the war obstructions, to clear the channel to Smithfield of all snags, logs, and overhanging trees, to contract the channel way by jetties so as to insure during the entire year an unobstructed 8-foot navigation to Newbern, a similar 4-foot navigation to Kinston, and during nine months annually a 3-foot navigation to Smithfield, at a total final estimated cost of $374,000.

To June 30, 1893, $262,535.42 had been expended upon this work.

At that date there was a good navigable channel 8 feet deep to Newbern, but between Newbern and Kinston there were numerous shoals upon which for short distances the depth was less than 4 feet prescribed in the project.

With the amount applied during the fiscal year ending June 30, 1894, the river from Kinston to Newbern has been fairly cleared of snags and the necessary surveys made preparatory to improving the shoals by the construction of jetties.

July 1, 1893, balance unexpended	$20,914.55
June 30, 1894, amount expended during fiscal year	5,541.64
July 1, 1894, balance unexpended	15,372.91
July 1, 1894, outstanding liabilities	751.73
July 1, 1894, balance available	14,621.18
Amount appropriated by act of August 17, 1894	7,000.00
Amount available for fiscal year ending June 30, 1895	21,621.18

Amount (estimated) required for completion of existing project	84,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	15,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix L 9.)

10. Inland waterway, between Newbern and Beaufort, N. C.—(Via Neuse and Clubfoot rivers, Clubfoot and Harlowe Canal, and Harlowe and Newport rivers to Beaufort Harbor). When the United States began to improve it in 1885 the shallow part from the Neuse River to Beaufort Harbor was navigable by boats 15 feet wide, with a draft of 1 foot at low water and about 2½ feet at high water.

The project of 1884 is to obtain a channel 30 feet wide at bottom and 5 feet deep at mean low water, from the Neuse River to Beaufort Harbor, by dredging in Clubfoot, Newport, and Harlowe rivers, and by improvement of the canal, at a cost estimated in 1886 at $92,000.

To June 30, 1893, $27,416.46 had been expended upon this work. At that date 2 feet could be carried through the canal at low water and 2½ feet at high water.

With the money applied during the fiscal year ending June 30, 1894, inspections have been made, and the traffic through the waterway observed and recorded. No work has been done.

July 1, 1893, balance unexpended	$7,711.18
June 30, 1894, amount expended during fiscal year	199.06
July 1, 1894, balance unexpended	7,512.12
July 1, 1894, outstanding liabilities	32.60
July 1, 1894, balance available	7,479.52
Amount (estimated) required for completion of existing project	57,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix L 10.)

11. Harbor at Beaufort, N. C.—When its improvement by the United States (begun in 1836) was resumed in 1881 the erosion of Fort Macon and Shackleford points and widening of the entrance between them caused serious shoaling of the channel on and inside the bar, across which there was then a mid-channel depth of not less than 15.3 feet at low water. Within the harbor from the Bulkhead Channel a draft of only 2 feet at low water could be carried to the wharves at Beaufort.

The project of 1881 was to stop the erosion at Fort Macon and Shackleford points by jetties; to prevent the widening and shoaling of the entrance to the harbor itself by deposit of eroded material; to dredge a channel 200 feet wide and 9 feet deep at low water from the Bulkhead Channel 1,950 feet to the wharves at Beaufort; and to dredge a channel 100 feet wide and 6 feet deep at mean low water from the 6-foot contour at Beaufort down the Old Town Channel and north of Horse Island to the 6-foot contour leading to North River, a distance of 12,670 feet.

In 1887 the project was modified by postponing for the present the dredging of the cut through the Old Town Channel to North River and by reducing to the width of 100 feet and depth of 5 feet the channel to be dredged from the Bulkhead Channel to Beaufort; and in 1890 the project was again modified by increasing the latter dredging to the depth of 7 feet at a cost estimated in 1887 at $163,000.

To June 30, 1893, $137,422.37 had been expended upon this work.

At that date the erosion of Fort Macon and Shackleford points had been arrested, and a cut 100 feet wide and 7 to 8 feet deep at low water had been dredged through the Bulkhead Channel a distance of 1,895 feet to the channel along the wharves at Beaufort; but at the entrance to the Bulkhead Channel from the main channel of the harbor a shoal had formed upon which the depth was 5.6 feet at low water and 8.6 feet at high water.

With the amount applied during the fiscal year ending June 30, 1894, the erosion of about 900 feet of the northerly shore of Shackleford Point has been arrested and the favorable condition of Fort Macon and Shackleford points preserved.

At low water the channel depth is 12 feet leading into the harbor and 5.3 feet to the wharves at Beaufort.

July 1, 1893, balance unexpended	$12,736.63
June 30, 1894, amount expended during fiscal year	2,977.09
July 1, 1894, balance unexpended	9,759.54
July 1, 1894, outstanding liabilities	365.65
July 1, 1894, balance available	9,393.89
Amount (estimated) required for completion of existing project	13,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix L 11.)

12. Inland waterway between Beaufort Harbor and New River, North Carolina.—When the first appropriation was made in 1886 there were in the 28 miles from Beaufort to Swansboro 6 shoals, aggregating about 4 miles in length, over which not more than 18 inches could be carried at low water. Elsewhere the channel was not less than 3 feet deep. From Swansboro 22 miles to New River the route followed intricate tidal sloughs varying from 1,000 to 12 feet in width and 10 feet to 6 inches in depth at high water.

The project adopted in 1885 embraced only that part of the route from Beaufort to Swansboro, and is to obtain a channel of the minimum depth of 3 feet and width of 100 feet by dredging through all the shoals, at an estimated cost of $50,000.

To June 30, 1893, $30,299.83 had been expended upon this work for this purpose.

At that date a channel of the variable widths of 40, 60, and 100 feet, and not less than 3 feet deep at low water, had been obtained by dredging through 6 shoals, aggregating 4.12 miles in length, but at two localities, aggregating 1,927 feet between shoals which had been dredged, there was a depth of less than 3 feet, and at the shoalest point of only 2½ feet at low water.

The amount expended during the fiscal year ending June 30, 1894, has been applied to surveys only.

July 1, 1893, balance unexpended	$9,700.17
June 30, 1894, amount expended during fiscal year	945.36
July 1, 1894, balance unexpended	8,754.81
July 1, 1894, outstanding liabilities	10.30
July 1, 1894, balance available	8,744.51
Amount appropriated by act of August 17, 1894	2,500.00
Amount available for fiscal year ending June 30, 1895	11,244.51
Amount (estimated) required for completion of existing project	7,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	7,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix L 12.)

13. Inland waterway between New River and Swansboro, N. C.—When the first appropriation was made, September 19, 1890, for its improvement, the crooked and intricate bayou which this waterway follows, 22 miles through the marshes between the mainland and outlying sand banks, had at low water a minimum depth of about 6 inches upon the shoals or "divides" where the tides meet between the four inlets to it from the ocean, and varied from 12 to 1,000 feet in width.

The project of 1889 is to dredge a channel 40 feet wide and 4 feet deep at high water through the shoals at a cost estimated at $43,000.

To June 30, 1893, $617.75 had been spent in surveying the shoals.

To this date, June 30, 1894, no work has been done, because the Wrightsville and Onslow Navigation Company claims to control the waterway under an act of the State of North Carolina of February 13, 1889. (See House Ex. Doc. No. 26, Fifty-second Congress, first session; also p. 1147, Annual Report Chief of Engineers, 1892.)

July 1, 1893, balance unexpended	$4,382.25
June 30, 1894, amount expended during fiscal year	2.25
July 1, 1894, balance unexpended	4,380.00
Amount (estimated) required for completion of existing project	38,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix L 13.)

14. New River, North Carolina.—In 1886, when the United States began to improve it around the marsh, commencing about 1½ miles within the bar, there was a narrow and circuitous channel about 7,000 feet in length and somewhat crooked, in places between beds of oyster rock, with two short shoals upon which the depth was only about 3 feet. Across the bar and, with the exception of these shoals, from the bar to Jacksonville, 23 miles above it, a draft of 5 feet could be carried.

In 1882 a project was adopted to improve the 7;000 feet of channel around the marsh by straightening and widening it to 150 feet, and deepening it to 5 feet, at an estimated cost of $23,000 to $40,000.

In 1885 the project was changed to dredge a straight channel 4 feet deep at mean low water, 150 feet wide, and about 5,710 feet long, through Cedar Bush Marsh, instead of improving the channel around it; also in place of the channel around Wrights Island, to dredge a channel of the above width and depth 1,200 feet in length through it.

August 9, 1892, the project was modified to leave the cut through Wrights Island as at that date, namely about 100 feet wide, and June 18, 1894, it was again modified to obtain, by a training wall and by dredging, a channel 4 feet deep through the shoals obstructing the circuitous natural channel around Cedar Bush Marsh, instead of maintaining the straight cut that had been dredged through the marsh.

To June 30, 1893, $20,442.35 had been expended upon this work.

At that date a channel 40 feet wide and 4 feet deep had been dredged 5,800 feet long through Cedar Bush Marsh, and 90 to 100 feet wide, 4 feet deep, and 1,200 feet long through Wrights Island. The channel at Cedar Bush Marsh had shoaled for a distance of 1,700 feet at its upper end, for about 1,000 feet of which distance the average depth was 2½ feet, and for about 100 feet it was only 18 inches at low water.

The cut through Wrights Island had scoured to the width of 100 feet and depth of 7 to 16 feet, but at its two ends and at the lower end of Cedar Bush Marsh cut shoals had formed, upon which there was only 2 to 3 feet of water at low tide. The natural channel around Wrights Island had narrowed to the minimum width of about 50 feet, but a draft of 5 feet could be carried through it and a draft of 3 feet through the natural channel around Cedar Bush Marsh.

The amount expended during the fiscal year ending June 30, 1894, has been applied to surveys only.

July 1, 1893, balance unexpended	$12,557.65
June 30, 1894, amount expended during fiscal year	1,083.97
July 1, 1894, balance unexpended	11,473.68
July 1, 1894, outstanding liabilities	87.31
July 1, 1894, balance available	11,386.37

Amount (estimated) required for completion of existing project	$7,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix L 14.)

15. North East (Cape Fear) River, North Carolina.—When the United States began to improve it in 1890, a draft of at least 6 feet could be carried up 48 miles to Bannermans bridge at lowest stage. From Bannermans bridge 55 miles up to Kornegays bridge the river is so shallow its navigation even by flatboats is not usually practicable for any periods of considerable duration, but is dependent upon freshet stages and therefore intermittent at all seasons of the year. Above Bannermans bridge it was badly obstructed by snags and overhanging trees.

The project of 1889 is to clear the channel to its natural depth and to a good width for small light-draft steamers up to Hallsville and for pole boats up to Kornegays bridge, at an estimated cost of $30,000.

To June 30, 1893, $5,074.15 had been expended upon this improvement.

At that date the channel to its natural depth and to a width of 40 feet had been cleared merely of its worst obstructions to a high-water navigation from Bannermans bridge up 31½ miles to Chinquepin, and again thoroughly cleared 4¾ miles from Rafting Oar to the vicinity of Coxs Bluff, 70 miles above the confluence.

With the amount applied during the fiscal year ending June 30, 1894, the channel for a width of 50 feet and to the full depth of water on the bars has been thoroughly cleared from Coxs Bluff up 29¾ miles to Millers Landing.

July 1, 1893, balance unexpended	$4,925.85
June 30, 1894, amount expended during fiscal year	2,925.91
July 1, 1894, balance unexpended	1,999.94
July 1, 1894, outstanding liabilities	272.22
July 1, 1894, balance available	1,727.72
Amount appropriated by act of August 17, 1894	5,000.00
Amount available for fiscal year ending June 30, 1895	6,727.72
Amount (estimated) required for completion of existing project	15,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	1,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix L 15.)

16. Black River, North Carolina.—When the United States began to improve this river in 1887 the channel from the mouth, 24 miles to Point Caswell, was fairly cleared to a depth not less than 4 feet at low summer stages, and was roughly cleared 62 miles farther to Lisbon, with a least channel depth of 2½ feet at low stage in the 10 miles from Point Caswell to Haws Narrows; thence 52 miles to Lisbon the depth at low summer stage was 18 inches to 3 feet on the shoals and 10 to 12 feet in the pools.

The project of 1885 was to apply at least $10,000 to removing logs, snags, and overhanging trees from the bed and banks and rounding off a few of the sharpest bends in the river from its confluence with the Cape Fear up 86 miles to Lisbon. In 1893 it was modified to confine the improvement to the 78 miles up to Clear Run.

To June 30, 1893, $7,874.57 had been expended upon this work.

At that date the channel had been well cleared from Clear Run down 18 miles, but the 24 miles thence to Point Caswell were much obstructed by snags, logs, and trees. The channel was also obstructed by shoals of sand at Goffs, Haws, and South River Narrows, where the water flows from the channel through swamps.

With the amount applied during the fiscal year ending June 30, 1894, 24 miles of channel have been cleared down to Point Caswell.

July 1, 1893, balance unexpended	$6,456.33
June 30, 1894, amount expended during fiscal year	4,130.15
July 1, 1894, balance unexpended	2,326.18
July 1, 1894, outstanding liabilities	4.85
July 1, 1894, balance available	2,321.33
Amount appropriated by act of August 17, 1894	2,000.00
Amount available for fiscal year ending June 30, 1895	4,321.33
Amount that can be profitably expended in fiscal year ending June 30, 1896, for maintenance	3,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

(See Appendix L 16.)

17. Cape Fear River above Wilmington, N. C.—When the United States began to improve it in 1882 a draft of 4 feet could be carried at lowest stages 50 miles above Wilmington to Browns Reach, thence 65 miles to Fayetteville there were 43 shoals aggregating about 16⅔ miles in length on which the depth was not more than 12 to 14 inches during the low stage; from Indian Wells Landing, 37 miles above Wilmington, 78 miles, to Fayetteville, the river was badly obstructed by snags, logs, and overhanging trees.

The project of 1881, as matured in 1885 and 1886, is to obtain at all times of the year a depth of 4 feet from Wilmington, 73 miles, to Elizabethtown, and of 3 feet thence, 42 miles, to Fayetteville, by removing snags and rock from the bed and overhanging trees from the banks, by contracting the channel by jetties on the shoals, and by a little dredging at a bar of clay, at a total cost, estimated in 1893, of $275,000.

To June 30, 1893, $112,330.20 had been expended upon this work.

At that date the channel was not less than 4 feet deep from Wilmington, 50 miles, to Browns Reach at all stages, and not less than 2.6 feet deep, 23 miles farther, to Elizabethtown, whence 42 miles, to Fayetteville the least low-water depth was 1.2 feet.

With the amount applied during the fiscal year ending June 30, 1894, the two most troublesome shoals on the river, Old Ferry, 9 miles, and Little Sugar Loaf, 49½ miles below Fayetteville, have been improved so as not to interfere with navigation.

July 1 1893, balance unexpended	$5,986.16
June 30, 1894, amount expended during fiscal year	3,597.50
July 1, 1894, balance unexpended	2,388.66
July 1, 1894, outstanding liabilities	327.67
July 1, 1894, balance available	2,060.99
Amount appropriated by act of August 17, 1894	14,000.00
Amount available for fiscal year ending June 30, 1895	16,060.99
Amount (estimated) required for completion of existing project	142,750.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	25,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

(See Appendix L 17.).

18. Cape Fear River at and below Wilmington, N. C.—The United States began to improve the river between the bar and Wilmington in 1829 and the channel on the bar in 1853. In 1829 the river was so obstructed that vessels drawing more that 10 feet were obliged to anchor 14 miles below Wilmington and discharge a part of their cargoes into lighters. In 1853, at low water on the bar, the least mid-channel depth was 7 feet in the western channel, 7½ feet in the eastern channel, and 8 feet at New Inlet 7 miles above the mouth.

The original project of 1827 was to deepen the channel through the shoals in the 8 miles next below Wilmington by contracting it by jetties and by diverting into it water from Brunswick River and from Fishing and Rodmans creeks.

The project of 1853 was to straighten and deepen the channel on the bar by building jetties and a wing dam, by dredging, by diverting water through it from New Inlet, by building a jetty at Federal Point, and by closing two small breaches in Zekes Island.

The project of 1870 was to deepen the bar channel by closing the breaches between Smiths and Zekes islands, with the ultimate closure of New Inlet in view.

The project of 1873, to deepen the channel through the bar, added to that of 1870, to dredge in the Baldhead (eastern) Channel, to extend across Zekes Island and beyond it into the river, the dam then being built to close the breaches between Smiths and Zekes islands, and to close New Inlet, commencing with the building of a jetty from Federal Point.

The project of 1874 was "to get 12 feet at low water as high as the city of Wilmington" by dredging a channel 100 feet wide through Horseshoe Shoal below New Inlet and through three other shoals near Wilmington.

The project of 1881 was to dredge a channel 2¾ miles in length through Horseshoe Shoal, and through eight other shoals above it 270 feet wide and 16 feet deep at mean low water from deep water at Smithville (Southport) to Wilmington.

February 28, 1889, pursuant to a requirement of the river and harbor act of August 11, 1888, the cost of obtaining a channel 20 feet deep at mean low water from Wilmington to the ocean was reported to be $1,800,000. In the Annual Report for 1889 it was reported that an additional appropriation of $25,000 would be required to complete the project of 1881 and obtain a channel 16 feet deep from Wilmington to the ocean. By the river and harbor act of September 19, 1890, Congress appropriated $170,000 for improving the Cape Fear River at and below Wilmington, and December 24, 1890, a contract was entered into for dredging to the depth of 20 feet, which commenced at Wilmington January 19, 1891, and ceased at Brunswick River shoal, 4½ miles below Wilmington, September 7, 1892.

Since September 7, 1892, work has been in progress to obtain a channel through the shoals between Wilmington and the bar and on the latter 18 feet deep at mean low water.

To June 30, 1893, $2,665,171.33 (including outstanding liabilities) had been expended upon this improvement.

At that date the depth at mean low-water was on the outer bar 18.2 feet and on its inner shoals 15.2 feet, on Snows Marsh Shoal, 7 miles above the bar, 14.2 feet, and on two other shoals, Lilliput and Midnight, between Snows Marsh and Wilmington, 14 and 15 feet respectively. The minimum channel depth was therefore 15.2 feet on the bar and 14 feet in the river.

With the amount applied during the fiscal year ending June 30, 1894, a channel of the variable widths of 50 to 209 feet has been obtained from Wilmington, 22 miles, to Snows Marsh 18 feet in depth, with the exception of the lower extremity of Lilliput Shoal, where, since dredging, it has shoaled to 16.5 feet at mean low water, with a bottom of very soft sludge.

July 1, 1893, balance unexpended		$178,054.59
June 30, 1894, amount expended during fiscal year		76,516.25
July 1, 1894, balance unexpended		101,538.34
July 1, 1894, outstanding liabilities	$21,773.12	
July 1, 1894, amount covered by uncompleted contracts	32,349.68	
		54,122.80
July 1, 1894, balance available		47,415.54
Amount appropriated by act of August 17, 1894		200,000.00
Amount available for fiscal year ending June 30, 1895		247,415.54

Amount (estimated) required for completion of existing project:	
If to 18 feet	200,000.00
If to 20 feet	1,230,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	250,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix L 18.)

19. Lockwoods Folly River, North Carolina.—When the United States began this improvement in 1892, the depth on the changeable ocean bar was usually 4 feet at low and 8 feet at high water. These depths could be carried at low stages 1½ miles up the channel to a mud flat, over which, for 1½ miles, the channel depth averaged less than 1 foot at low water. A little above these flats there was a shoal 300 feet long upon which the depth at low water was about 2½ feet, thence about 22 miles by river to Lockwoods Folly bridge the depth was nowhere less than 5 feet.

The project was adopted in 1887 to dredge a channel through the flats 100 feet wide and 7 feet deep at low water.

To June 30, 1893, $4,975.14 had been expended.

At that date one cut, 40 feet wide and 5 feet deep at low water, had been dredged the length of 2,530 feet, about one-third of the distance, through the shoal.

The amount ($3,000) appropriated July 13, 1892, being too small to form a contract for dredging at an advantageous rate, the Secretary of War, August 4, 1892, authorized it to be withheld from expenditure for the present, and no work has been done during the fiscal year ending June 30, 1894.

July 1, 1893, balance unexpended	$3,024.86
June 30, 1894, amount expended during fiscal year	24.86
July 1, 1894, balance unexpended	3,000.00
Amount appropriated by act of August 17, 1894	10,000.00
Amount available for fiscal year ending June 30, 1895	13,000.00

Amount (estimated) required for completion of existing project	22,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	22,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix L 19.)

20. Georgetown Harbor, South Carolina.—This harbor is that part of the Sampit River immediately within the bar at its mouth, near the head of Winyaw Bay.

When the United States began to improve it in 1884 there was in the channel on the ocean bar at the mouth of the bay at low water about 8¾ feet and about 12 feet at high water; thence up the bay there was a depth of 13 feet to the bar at the mouth of the Sampit, upon which there was only 9 feet at ordinary low water.

The project of 1881 was to dredge a channel 200 feet wide to the depth of 12 feet at ordinary low water through this shoal or bar to permit vessels to reach the wharves at Georgetown.

To June 30, 1893, $42,228.31 had been expended upon this work.

At that date a channel 12 feet deep had been dredged entirely through the shoal to the prescribed width of 200 feet.

With the amount applied during the fiscal year ending June 30, 1894, 34 logs and 2 stumps were removed in maintenance of the channel, and four beacons built to guide vessels clear of its banks.

July 1, 1893, balance unexpended	$2,271.69
June 30, 1894, amount expended during fiscal year	644.11
July 1, 1894, balance unexpended	1,627.58
July 1, 1894, outstanding liabilities	2.60
July 1, 1894, balance available	1,624.98

(See Appendix L 20.)

21. Winyaw Bay, South Carolina.—When the United States began to improve it in 1890, there was at mean low water in the main (southerly) channel on its ocean bar 7 to 9 feet, and in the Bottle (easterly) Channel 6 to 8 feet of water, both channels being changeable; thence 12 miles to the head of the bay vessels could draw 12 feet at lowest tides.

The project of 1885, as approved by the Board of Engineer Officers in 1888 and by the Chief of Engineers in 1889, is to increase the depth of water in Bottle Channel to about 15 feet at mean low water by building to the height of 6 feet above that plane a jetty from North Island 10,700 feet long and a jetty from South Island 17,500 feet long across the main channel to the 18-foot curve, at a total estimated cost of $2,500,000.

To prevent the overflow to the depth of about 1 foot at mean high water of a wide expanse of marsh on the southerly side of the entrance to the bay (ensuing from the degradation of about 3 miles of beach) and hurtful changes to the tidal régime of the bay, a dike not less than 10,500 feet in length is to be built at a cost of about $3.24 per linear foot, by authority from the Chief of Engineers of May 10, 1892.

To June 30, 1893, $272,528.88 (including outstanding liabilities) had been expended upon this work.

At that date the north jetty had been built to a distance of 2,220 feet from the shore and height of 18 inches above mean low water.

With the amount applied during the fiscal year ending June 30, 1894, the mattresses with ballast and jetty to partial height have been extended 1,279 feet. There has been no increase in depth on the bar since the jetty was commenced.

July 1, 1893, balance unexpended		$67,470.19
June 30, 1894, amount expended during fiscal year		34,588.49
July 1, 1894, balance unexpended		32,881.70
July 1, 1894, outstanding liabilities	$2,949.88	
July 1, 1894, amount covered by uncompleted contracts	27,213.81	
		30,163.69
July 1, 1894, balance available		2,718.01
Amount appropriated by act of August 17, 1894		110,000.00
Amount available for fiscal year ending June 30. 1895		112,718.01

Amount (estimated) required for completion of existing project	$2,071,250.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	600,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

(See Appendix L 21.)

22. Removing sunken vessels or craft obstructing or endangering navigation.—The removal of the wreck of the schooner *George G. Green* which was dangerous to navigation in 8½ fathoms of water in the track of vessels 16 miles from the mouth of the Cape Fear River, was authorized December 15, 1893, but was removed by the U. S. dynamite gunboat *Vesuvius*.

The removal of the wreck of the schooner *Enchantress*, at the westerly verge of the channel of the Cape Fear River just below Wilmington, which was a dangerous obstruction to navigation, was authorized December 23, 1893, but its removal is now in progress by the owners of the cargo.

December 13, 1893, a sunken three-masted schooner was reported 10½ miles NE. ¼ N. from Cape Hatteras. Unless it has been removed by the U. S. dynamite gunboat *Vesuvius* its removal will be undertaken in July, 1894.

December 28, 1893, a sunken wreck was reported about 12 miles S. by E. magnetic from Cape Lookout light-house. A search failing to find it, the sum of $300 was allotted for searching for this wreck and for two others which were rumored to be in the locality and dangerous to navigation. The former wreck was removed and the two latter examined and found by the master of the U. S. revenue cutter *Colfax* in June, 1894, to be not dangerous to navigation.

(See Appendix L 22.)

IMPROVEMENT OF WACCAMAW AND LUMBER RIVERS, NORTH CAROLINA AND SOUTH CAROLINA, AND OF CERTAIN RIVERS AND HARBORS IN SOUTH CAROLINA.

This district was in the charge of Capt. Frederic V. Abbot, Corps of Engineers; Division Engineer, Col. William P. Craighill, Corps of Engineers.

1. Waccamaw River, North Carolina and South Carolina.—In 1880 this river was navigable for boats of 12 feet draft at all stages of water from Georgetown 23 miles to Bull Creek, and at high water 4 miles farther to Buck's lower mills; thence for boats of 7 feet draft at high water 22 miles farther to Conway; thence it possessed an obstructed channel for boats of 3 feet draft at ordinary winter water 68 miles to Reeves Ferry; thence an obstructed channel with 3 feet depth at high water 30 miles to Lake Waccamaw.

The project provides for a channel 12 feet deep at all stages of water and 80 feet bottom width from the mouth of the river to Conway; thence a cleared channel to Lake Waccamaw. The estimated cost is $138,400.

The work of the year has been snagging. Up to June 30, 1894, $86,853.10 has been spent, giving a thoroughly cleared channel with 100 feet least width, 7 feet deep at low water, as far as Conway, and 40 feet width and 3 feet deep 72 miles above Conway.

The commerce of the year amounts to 99,298 tons.

July 1, 1893, balance unexpended	$4,801.30
June 30, 1894, amount expended during fiscal year	3,754.40
July 1, 1894, balance unexpended	1,046.90
July 1, 1894, outstanding liabilities	101.05
July 1, 1894, balance available	945.85
Amount appropriated by act of August 17, 1894	6,000.00
Amount available for fiscal year ending June 30, 1895	6,945.85
Amount (estimated) required for completion of existing project	44,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	30,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

(See Appendix M 1.)

2. Lumber River, North Carolina and South Carolina.—The river was obstructed by logs, snags, and overhanging trees, and in places by sand bars. It was crossed by a number of bridges without draws. The project contemplates the removal of snags, logs, overhanging trees, etc., for 70 miles below Lumberton at an estimated cost of $35,000. The work of the year has been snagging. The railroad bridge in South Carolina has been supplied with a steel draw. The North Carolina bridges have been provided with draw-spans or discontinued. The commerce of the year amounts to 10,550 tons. Total expenditures to June 30, 1894, $14,912.07.

July 1, 1893, balance unexpended	$1,932.04
June 30, 1894, amount expended during fiscal year	1,844.11
July 1, 1894, balance unexpended	87.93
July 1, 1894, outstanding liabilities	56.00
July 1, 1894, balance available	31.93
Amount appropriated by act of August 17, 1894	4,000.00
Amount available for fiscal year ending June 30, 1895	4,031.93
Amount (estimated) required for completion of existing project	16,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	16,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

(See Appendix M 2.)

3. Little Pedee River, South Carolina.—The river was much obstructed by snags and overhanging trees, and in places was subdivided into several branches. The project contemplates providing for steamboat navigation to Lumber River and pole-boat navigation to Little Rock. The estimated cost is $50,000. All bridges on that part of river improved for steamers have been supplied with draws. No work has been done during the year. This year's commerce amounts to 8,375 tons. Total expenditures to June 30, 1894, $14,218.18.

July 1, 1893, balance unexpended	$2,416.14
June 30, 1894, amount expended during fiscal year	1,634.32
July 1, 1894, balance unexpended	781.82
July 1, 1894, outstanding liabilities	279.00
July 1, 1894, balance available	502.82
Amount appropriated by act of August 17, 1894	4,000.00
Amount available for fiscal year ending June 30, 1895	4,502.82

Amount (estimated) required for completion of existing project	$31,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	20,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix M 3.)

4. *Great Pedee River, South Carolina.*—The river was dangerously obstructed by snags and logs. The project provides for thoroughly cleared 9-foot navigation 52 miles to Smith Mills, and 3½-foot navigation to Cheraw, 172 miles above the mouth, at all stages of water, at an estimated cost of $117,000. The work of the year has been snagging. This year's commerce amounts to 91,025 tons. Total expenditures to June 30, 1894, $87,352.37.

July 1, 1893, balance unexpended	$6,178.28
June 30, 1894, amount expended during fiscal year	4,030.65
July 1, 1894, balance unexpended	2,147.63
July 1, 1894, outstanding liabilities	219.00
July 1, 1894, balance available	1,928.63
Amount appropriated by act of August 17, 1894	6,000.00
Amount available for fiscal year ending June 30, 1895	7,928.63

Amount (estimated) required for completion of existing project	21,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	21,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix M 4.)

5. *Clark River, South Carolina.*—This river forms the southern mouth of Lynch River. Its upper end was entirely choked by driftwood and fallen trees. The project provides for closing the northern mouth of Lynch River and snagging Clark River. The estimated cost is $7,500. No work has been done during the year. All that is needed before Lynch River is opened for steamers has been done. This year's commerce amounts to about 7,000 tons. Total expenditures to June 30, 1894, $7,464.58.

July 1, 1893, balance unexpended	$413.81
June 30, 1894, amount expended during fiscal year	378.39
July 1, 1894, balance unexpended	35.42

(See Appendix M 5.)

6. *Mingo Creek, South Carolina.*—This stream was much obstructed by snags and overhanging trees. The project provides for removing obstructions from the mouth to Williams Landing for steamboat navigation and above for pole-boat navigation. The estimated cost is $17,000. The work of the year has been snagging. This year's commerce amounts to 114,375 tons. Total expenditures to June 30, 1894, $12,968.94.

July 1, 1893, balance unexpended	$1,453.98
June 30, 1894, amount expended during fiscal year	1,422.92
July 1, 1894, balance unexpended	31.06
Amount appropriated by act of August 17, 1894	4,000.00
Amount available for fiscal year ending June 30, 1895	4,031.06

(See Appendix M 6.)

7. *Santee River, South Carolina.*—This river was obstructed by sunken logs and snags. The bar was narrow, crooked, and shifting, with only about 4 feet depth at low tide. The project provides for leaving the

Mosquito Creek Canal, which has been completed for about $100,000, as a lumber route, and for a new cut between Estherville and Minim Creek, at an estimated cost of $250,000, and for completely snagging the Santee River itself at a cost of $100,000. During the past year dredging on the new canal continued with the new dredge owned and operated by the United States, at a cost of between 3 and 4 cents a cubic yard. The lowest price here by contract was over 35 cents—about ten times greater than this year's cost by hired labor.

Up to June 30, 1894, $158,015.62 had been spent in giving a passage 30 feet wide and 5 feet deep at high water, from Santee River to Winyaw Bay, in building a drawbridge over Mosquito Creek, in replacing damaged rice drainage, and dredging on the new Estherville-Minim Creek Canal. This year's commerce amounts to 115,428 tons.

July 1, 1893, balance unexpended	$16,040.37
June 30, 1894, amount expended during fiscal year	14,305.99
July 1, 1894, balance unexpended	1,734.38
July 1, 1894, outstanding liabilities	431.46
July 1, 1894, balance available	1,302.92
Amount appropriated by act of August 17, 1894	40,000.00
Amount available for fiscal year ending June 30, 1895	41,302.92
Amount (estimated) required for completion of existing project	250,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	200,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

(See Appendix M 7.)

8. *Wateree River, South Carolina.*—This river had a low-water depth of from 3 to 4 feet from its mouth 67 miles, to Camden. It was much obstructed by snags and by two railroad bridges without draws. The project provides for 4-foot steamboat navigation to Camden. Total expenditures to June 30, 1894, $61,929.74.

The appropriation of September 19, 1890, completes the original estimated cost, and for this sum the river has been put into a satisfactory condition. The engineer officer in charge reports that an annual appropriation of $6,500 is needed for maintenance. This year's commerce amounts to 18,075 tons.

July 1, 1893, balance unexpended	$3,045.66
June 30, 1894, amount expended during fiscal year	2,475.40
July 1, 1894, balance unexpended	570.26
July 1, 1894, outstanding liabilities	85.00
July 1, 1894, balance available	485.26
Amount appropriated by act of August 17, 1894	2,500.00
Amount available for fiscal year ending June 30, 1895	2,985.26
Amount that can be profitably expended in fiscal year ending June 30, 1896	6,500.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

(See Appendix M 8.)

9. *Congaree River, South Carolina.*—This river had a low-water depth of from 3 to 4 feet from its mouth 48 miles to the railroad bridge at Columbia, thence 1-foot low-water depth 2 miles farther. The lower 47 miles, from Granby to the mouth, was blocked by snags and a railroad bridge without a draw. The 3 miles above Granby was impassable, being rapids. The original project provides for 4-foot navigation below Granby, and a cleared channel through the rapids above.

A new project, submitted in accordance with House resolution of December 15, 1893, provides for the same depth up to Columbia. The work of the year has been snagging. Total expenditures to June 30, 1894, $24,501.75. This year's commerce amounts to 7,974 tons.

July 1, 1893, balance unexpended	$3,007.74
June 30, 1894, amount expended during fiscal year	2,509.49
July 1, 1894, balance unexpended	498.25
July 1, 1894, outstanding liabilities	127.20
July 1, 1894, balance available	371.05
Amount appropriated by act of August 17, 1894	4,000.00
Amount available for fiscal year ending June 30, 1895	4,371.05
Amount (estimated) required for completion of existing project	25,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	25,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix M 9.)

10. Charleston Harbor, South Carolina.—The work in progress since 1878 comprises two jetties of riprap with mattress foundation, and in some places of mattress hearting. The jetties spring from Morris and Sullivan islands and converge on curves so as to cross the bar on parallel lines about 2,900 feet apart. They are to establish and maintain a channel across the bar not less than 21 feet deep at low water where heretofore the low-water depth has not exceeded 12 feet. The action of the jetties is to be assisted by dredging. Estimated cost for jetties up to low water, $4,380,500; up to 3 feet above mean low water, $5,334,500.

Dredging continued throughout the year, under contract with Messrs. Egan & Friday, using the Government dredge. Stonework continued under the contract with the same firm. During the year 214,232 tons of stone was deposited on the jetties, and 503,055 cubic yards of material was dredged. No settlement of the jetties has occurred during the year, but some of the very high portions had the top knocked off down to high-water mark during the hurricane of August 27, 1893. No practical injury was done to either jetty by this storm. About 2¼ miles of the South Jetty and 1¾ miles of the North Jetty have been raised to high water since work began.

The annual survey shows a marked improvement in the jetty channel. There is now 17 feet of water, sufficiently wide for navigation, all the way through at low tide. Total expenditures to June 30, 1894, $2,940,234.64.

July 1, 1893, balance unexpended		$631,285.33
June 30, 1894, amount expended during fiscal year		394,019.97
July 1, 1894, balance unexpended		237,265.36
July 1, 1894, outstanding liabilities	$370,600.00	
July 1, 1894, amount covered by uncompleted contracts	1,126,461.26	
		1,497,061.26
Amount appropriated by sundry civil act of August 18, 1894		450,000.00
Amount (estimated) required for completion of existing project		753,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896		753,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.		

(See Appendix M 10.)

11. Ashley River, South Carolina.—The plan of improvement comprises the removal of a shoal about 8 miles above the city of Charleston, S. C., where there was only 9 feet of water at low tide, and another just below the Wando Phosphate Works, where there was only 6 feet. Low-water depths of from 10 to 11 feet, with widths of from 100 feet to 200 feet, have been obtained. This year's commerce amounts to 525,000 tons. Total expenditures to June 30, 1894, $5,498.23.

July 1, 1893, balance unexpended	$2.81
June 30, 1894, amount expended during fiscal year	1.04
July 1, 1894, balance unexpended	1.77

(See Appendix M 11.)

12. Wappoo Cut, South Carolina.—The project provides for a channel 60 feet wide and 6 feet deep at low water between Ashley and Stono rivers. There is now a narrow 5½-foot channel all the way through. This year's commerce amounts to 242,000 tons. Total expenditures to June 30, 1894, $50,284.28.

July 1, 1893, balance unexpended	$2,715.72
July 1, 1894, balance unexpended	2,715.72
Amount appropriated by act of August 17, 1894	7,000.00
Amount available for fiscal year ending June 30, 1895	9,715.72
Amount (estimated) required for completion of existing project	28,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	28,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix M 12.)

13. Edisto River, South Carolina.—The river was much obstructed by snags and shoals. The project provides for a channel for rafts and flatboats from the sea, 260 miles, to Guignard Landing, on the South Fork, at an estimated cost of $33,385. No work has been done during the year. The project has been satisfactorily completed for less than the estimated cost.

This year's commerce amounts to 120,870 tons. Total expenditures to June 30, 1894, $33,010.30.

The sum of $2,500 could be advantageously expended in removing obstructions which fell into the river during the hurricanes of August and October, 1893.

July 1, 1893, balance unexpended	$449.15
June 30, 1894, amount expended during fiscal year	74.45
July 1, 1894, balance unexpended	374.70
July 1, 1894, outstanding liabilities	14.80
July 1, 1894, balance available	359.90
Amount (estimated) required for completion of existing project	2,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	2,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix M 13.)

14. Salkahatchie River, South Carolina.—The river was very much obstructed by snags. The project provides for a continuous flatboat channel from 5 miles above Toby Bluff to Hickory Hill, at an estimated cost of $18,000. This year's commerce has amounted to 27,000 tons. The last appropriation completes the estimated cost and no further funds will be required, the improvement being completed and a sufficient balance being left for maintenance. Total expenditures to June 30, 1894, $15,378.85.

July 1, 1893, balance unexpended	$3,758.34
June 30, 1894, amount expended during fiscal year	1,137.19
July 1, 1894, balance unexpended	2,621.15
July 1, 1894, outstanding liabilities	12.00
July 1, 1894, balance available	2,609.15

(See Appendix M 14.)

15. Beaufort River, South Carolina.—The portion to be improved is near Coosaw River, where there was only about 4 feet depth at low water for a short distance. A through channel 7 feet deep has been provided by dredging, as projected. The estimated cost is $40,000. Total expenditures to June 30, 1894, have been $24,970.93. The amount appropriated was not sufficient to give the required width, as more rock was encountered than was anticipated. As recommended by the district engineer, the original estimate ($25,000) has been increased by $15,000. This year's commerce amounts to 215,000 tons.

July 1, 1893, balance unexpended	$62.77
June 30, 1894, amount expended during fiscal year	33.70
July 1, 1894, balance unexpended	29.07
July 1, 1894, outstanding liabilities	6.00
July 1, 1894, balance available	23.07
Amount appropriated by act of August 17, 1894	5,000.00
Amount available for fiscal year ending June 30, 1895	5,023.07
Amount (estimated) required for completion of existing project	10,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix M 15.)

16. Removing sunken vessels or craft obstructing or endangering navigation— Wreck of schooner Kate V. Aitken, in Swash Channel, Charleston Harbor, South Carolina.—At the close of the last fiscal year a contract was let to Messrs. Charles W. Johnston and Enoch Townsend, to remove this wreck for the sum of $4,745. They began work and succeeded in removing a portion of the vessel, but from the start failed to comply with the specifications regarding the disposition of cargo and vessel. They requested an extension of time, which was granted them. Up to the close of the fiscal year they had not resumed work. Their extension of time expires August 31, 1894.

Wreck of sloop in drawspan of Ashley River Bridge.—During the gale of August 27, 1893, a small sloop sunk in over 30 feet of water in the draw opening of the above bridge. Her mast is an obstruction to navigation. The rest of the boat is so deeply submerged as to be out of the way. Five dollars was allotted for removing the mast. At the close of the year this had not been done, as the parties who were repairing the bridge had promised to pull it out for that price, but had failed to do so.

The expenditures during the year have aggregated $366.67.

(See Appendix M 16.)

IMPROVEMENT OF RIVERS AND HARBORS IN EASTERN GEORGIA.

This district was in the charge of Capt. O. M. Carter, Corps of Engineers; Division Engineer, Col. William P. Craighill, Corps of Engineers.

1. Savannah Harbor, Georgia.—The plan of improvement under which operations have been carried on in Savannah Harbor during the last fiscal year was approved by the Secretary of War on July 22, 1890. The project contemplates the establishment of a navigable channel 26 feet deep at mean high water between the city of Savannah and Tybee Roads. The mean rise and fall of tides varies from about 7 feet at Fort Pulaski to about 6 feet in front of the city wharves.

The estimated cost of the improvement is $3,500,000.

In 1873, prior to improvement, the channel was in places not more than 9 feet deep at mean low water, and the usual high-water draft of vessels was not more than 14.5 feet.

Prior to July 1, 1893, there had been placed in the work under the present project 312,887.35 square yards of log and brush mattresses, 37,638.14 cubic yards of stone, 118,483.23 cubic yards of brush fascines, 5,844 piles, and, aside from these, 268 groups of tie piles, and 51 clusters of fender piles; also 302,027.60 feet, B. M., of 6 by 10 inch timber, and 33,399.1 pounds of iron bolts. There had been removed from the channel, by dredging, 920,833.84 cubic yards of material.

The river and harbor act approved July 13, 1892, contained an appropriation of $318,750 for continuing this improvement, with the following provision:

> *Provided,* That contracts may be entered into by the Secretary of War for such materials and work as may be necessary to complete the present project of improvement, to be paid for as appropriations may from time to time be made by law, not to exceed in the aggregate two million eight hundred and thirty-one thousand two hundred and fifty dollars, exclusive of the amount herein and heretofore appropriated.

A contract was entered into with P. Sanford Ross, of Jersey City, N. J., for all of the dredging, and with the Atlantic Contracting Company, of New York, for all of the other work required for the improvement.

During the fiscal year just closed there were used in the Marsh Island training wall and closing dam, in the Garden Bank training wall, the Fig Island jetty, the Mackay Point training wall, the South Channel training wall and spur dams, the Barnwell Island training wall and spur dams, the Barnwell Island closing dams, the North Elba Island training wall, the South Elba Island training wall, Wing Dam No. 14, Philbricks Cut dam, the Lower Flats training wall, the Venus Point training wall, Big Gap dam, the Jones Island spur dams, Wing Dam No. 33, the Long Island training wall, the Oyster Bed training wall, and the Cockspur Island training wall, 699,536.65 square yards of brush mattresses, 99,192.83 cubic yards of brush fascines, 57,633.63 cubic yards of riprap stone, 325,299 feet, B. M., of 6 by 10 inch sawed timber, 33,153.28 pounds of iron bolts. There were driven 6,155 piles, making an aggregate advance of pile work of 24,576.1 linear feet; 597 piles were driven as guides for the mattress work, which are an equivalent of 2,388 linear feet of pile work. There were also driven 441 groups of tie piles and 23 clusters of fender piles, making a total of 7,703 piles driven during the fiscal year.

Between the old waterworks and Tybee Knoll 978,096.80 cubic yards of material was removed by dredging during the fiscal year.

The removal of a number of old crib obstructions and wing dams projecting too far into the channel has been commenced by the snag boats *Toccoa* and the *Satilla,* the work being done by hired labor and the purchase of material in open market. The material thus far removed at various places consists of 2,400 feet, B. M., of sawed timber, 216¾ cubic yards of riprap stone, 2,759 logs, and 35 piles.

A steam hoister for use upon the rivers and in Savannah Harbor has been constructed by hired labor and purchase of material in open market.

Besides the usual examinations and surveys, preparations were made for a final gauging of the river.

The total amount expended under the present project to June 30, 1893, including all outstanding liabilities, amounted to $827,669.48.

There is now a navigable channel from the city to the sea with a minimum low-water depth of 16 feet, a gain of about 7 feet since the work was begun, and of half a foot during the fiscal year just closed.

July 1, 1893, balance unexpended		$1,000,102.20
June 30, 1894, amount expended during fiscal year		750,102.20
July 1, 1894, balance unexpended		250,000.00
July 1, 1894, outstanding liabilities	$653,864.58	
July 1, 1894, amount covered by uncompleted contracts	408,034.40	
		1,061,898.98
Amount appropriated by sundry civil act of August 18, 1894		975,000.00
Amount (estimated) required for completion of existing project		856,250.00
Amount that can be profitably expended in fiscal year ending June 30, 1896		856,250.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

(See Appendix N 1.)

2. *Savannah River, Georgia.*—The present project for the improvement of this river was adopted in 1890, the object being to secure a low-water steamboat channel, not less than 5 feet in depth, between the cities of Augusta and Savannah, Ga.

The estimated cost of the improvement is $332,000. Prior to improvement navigation was much impeded by logs, snags, piles, and other obstructions. The depth at summer low water over some of the shoals did not exceed 2 or 3 feet.

The total amount expended under the present project to June 30, 1893, including all outstanding liabilities, was $34,105.35, and resulted in removing 1,508 snags, stumps, and logs, and 11,849 overhanging trees from the most troublesome places throughout the whole extent of the river. Seven spur dams were constructed for the protection of caving banks below the city of Augusta, and some of the old dams were repaired. There were placed in this work 4,861.40 cubic yards of brush fascines, and 3,352.47 cubic yards of stone.

There have been removed from the river during the present fiscal year 306 snags, logs, and stumps, and 359 overhanging trees; 15 logs were cut up on bank.

Under a contract with Albert J. Twiggs, of Augusta, Ga., 35 new spur dams were constructed near that city and a number of old ones were repaired. There were placed in this work 7,232.04 cubic yards of brush fascines and 6,742.46 cubic yards of stone.

The expenditures during the year ending June 30, 1894, including all outstanding liabilities, amounted to $22,760.62, and resulted in protecting the caving banks of the river near Augusta and in removing the most serious obstructions to navigation between Savannah and Augusta.

July 1, 1893, balance unexpended	$26,023.59
June 30, 1894, amount expended during fiscal year	22,730.67
July 1, 1894, balance unexpended	3,292.92
July 1, 1894, outstanding liabilities	29.95
July 1, 1894, balance available	3,262.97
Amount appropriated by act of August 17, 1894	15,000.00
Amount available for fiscal year ending June 30, 1895	18,262.97

Amount (estimated) required for completion of existing project	$257,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	100,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix N 2.)

3. *Savannah River above Augusta, Ga.*—The present project for the improvement of this part of Savannah River is outlined in report of Capt. O. M. Carter, Corps of Engineers, dated January 31, 1890, and adopted in 1892. It contemplates the establishment of a pole-boat channel between Petersburg, Ga., and the Locks, above Augusta, Ga., 12 to 25 feet wide and navigable at ordinary summer low water for boats drawing 2 feet. This is to be accomplished by the removal of sand shoals, ledges of rock or gravel, and overhanging trees, and by the construction of spur dams and training walls to maintain the depth of the improved channel.

The estimated cost of the improvement is $33,000.

Prior to July 1, 1892, there was no work done under the present project.

The total amount expended under the present project up to June 30, 1893, including all outstanding liabilities, was $9,956.64, and resulted in the building of new dams and the repairing of old ones and the excavation of rock from the channel at various places. There were used in this work 2,018.66 cubic yards of fascines, 1,186.30 cubic yards of riprap stone, and there was excavated from the channel 341.5 cubic yards of rock, using 200 pounds of explosives.

Operations during the fiscal year just closed were, owing to lack of funds, confined to office work.

The total amount expended under the present project to June 30, 1894, is $10,000.

July 1, 1893, balance unexpended	$4,180.08
June 30, 1894, amount expended during fiscal year	4,180.08
Amount appropriated by act of August 17, 1894	6,000.00

Amount (estimated) required for completion of existing project	17,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	17,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix N 3.)

4. *Darien Harbor, Georgia.*—The plan of improvement under which operations have been carried on in Darien Harbor during the last fiscal year was adopted in 1885. The project contemplates the establishment of a navigable channel 12 feet deep at mean low water between Darien and Doboy. The mean rise and fall of the tide is about 6.5 feet.

The estimated cost of the improvement is $170,000.

No work was ever done under the existing project prior to the fiscal year ending June 30, 1891.

The total expenditures under the present project of improvement to June 30, 1893, including all outstanding liabilities, amounted to $49,546.68, and resulted in the removal by dredging of 86,640.2 cubic yards of material from various shoals and in the construction of 20 spur dams, of an aggregate length of 4,172.6 feet.

Owing to the lack of funds, operations during the fiscal year just closed were confined to an examination of the harbor and miscellaneous office work.

The total expenditures under the present project of improvement to June 30, 1894, amounted to $50,000.

July 1, 1893, balance unexpended	$557.44
June 30, 1894, amount expended during fiscal year	557.44
Amount appropriated by act of August 17, 1894	25,000.00

Amount (estimated) required for completion of existing project	95,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	95,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

(See Appendix N 4.)

5. *Altamaha River, Georgia.*—The plan of improvement under which operations have been carried on upon the Altamaha River during the last fiscal year was adopted in 1890.

The project contemplates the establishment of a steamboat channel 3 feet in depth at ordinary summer low water between Darien and the junction of the Oconee and Ocmulgee rivers.

The estimated cost of the improvement is $129,000.

Prior to improvement navigation was much impeded by logs, snags, and other obstructions, the low-water depths at some points not exceeding 2 feet.

The total amount expended under the present project to June 30, 1893, including all outstanding liabilities, was $26,406.64, and resulted in removing 741 snags and stumps and 2,786 overhanging trees; 26 logs were cut on bank. At Beards Bluff 3,166 linear feet of wattled pile dam was built, and at Marrowbone Bar 79 linear feet of shore protection. In this work there were used 482 piles, 2,462 square yards and 1,630 cubic yards of brush mattresses, and 371 cubic yards of riprap stone. All this work was done by hired labor and purchase of material in open market. There were constructed at Couper Bar a training wall and 3 spur dams, aggregating 932 feet in length, in the construction of which there were used 4,390.11 cubic yards of brush fascines, 141.51 cubic yards of riprap stone, 12,502.25 feet, B. M., of 6 by 10 inch timber, as waling, cross and back ties, and 1,285.40 pounds of iron bolts for the fastening of the timber to the pile work. There were driven 471 piles, 26 groups of tie piles, and 11 clusters of fender piles, making a total of 556 piles. This work was done by contract.

There were removed from the river during the fiscal year just closed 342 snags and stumps and 4,533 overhanging trees; 5 logs were cut up on bank. The snag boat also removed the wreck of the steamer *Tar Heel*, which was lying in the channel at Oswells Cut. At Beards Bluff 66 fender piles were driven, and at Town Bluff Shoal 45 cubic yards of rock was removed from the channel. All this work was done by hired labor and purchase of material in open market.

The expenditures during the fiscal year ending June 30, 1894, resulted in improving the channel at Town Bluff and in removing the most serious obstructions to navigation over the entire length of the river.

July 1, 1893, balance unexpended	$4,214.79
June 30, 1894, amount expended during fiscal year	3,521.26
July 1, 1894, balance unexpended	693.53
Amount appropriated by act of August 17, 1894	10,000.00
Amount available for fiscal year ending June 30, 1895	10,693.53

Amount (estimated) required for completion of existing project	89,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	50,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

(See Appendix N 5.)

6. *Oconee River, Georgia.*—The plan of improvement under which operations have been carried on upon the Oconee River during the last fiscal year was adopted in 1890.

The project contemplates the establishment of a steamboat channel 3 feet in depth at ordinary summer low water, between Milledgeville and the mouth of the river.

The estimated cost of the improvement is $171,000.

Prior to improvement, navigation was much impeded by sand bars, overhanging trees, snags, and sunken logs. On some shoals there were low-water depths of not more than 2 feet.

Prior to July 1, 1893, there were removed from the channel, under the present project, 3,096 snags and stumps, 17,061 overhanging trees, and 366.5 cords of driftwood; 131 trees were girdled, and 269 logs were cut up on bank. There was placed in the closing dam at Fish Trap Cut 600 cubic yards of stone. In building spur dams at Old Boat Yard there were driven 165 piles; 935 linear feet of piling was wattled with poles, and 991 linear feet of brush mattresses 18 feet wide was sunk. A new snag boat, the *Satilla*, was completed October 3, 1891.

The total amount expended under the present project to June 30, 1893, including all outstanding liabilities, is $33,264.15.

There were removed from the channel during the fiscal year just closed 6,819 snags and stumps, 5,672 overhanging trees, and 266⅔ cubic yards of gravel, clay, and sand; 503 logs were cut up on bank; 8 trees were girdled, and 966 pounds of explosives was used. In repairing the jetties at Old Boat Yard there were used 20 linear feet of brush mattresses 18 feet wide, 15 cubic yards of brush fascines, and 5 cubic yards of riprap stone; 11 piles were driven and 80 linear feet of pile-work was wattled; 165 pounds of explosives was used.

The total expenditures during the fiscal year ending June 30, 1894, including all outstanding liabilities, amounted to $16,327.84, and resulted in opening a navigable channel from the river's mouth to Milledgeville.

July 1, 1893, balance unexpended	$17,162.43
June 30, 1894, amount expended during fiscal year	16,231.84
July 1, 1894, balance unexpended	930.59
July 1, 1894, outstanding liabilities	96.00
July 1, 1894, balance available	834.59
Amount appropriated by act of August 17, 1894	10,000.00
Amount available for fiscal year ending June 30, 1895	10,834.59
Amount (estimated) required for completion of existing project	111,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	50,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix N 6.)

7. *Ocmulgee River, Georgia.*—The plan of improvement under which operations have been carried on upon the Ocmulgee River during the last fiscal year, was adopted in 1890. The project contemplates the establishment of a steamboat channel 3 feet in depth at ordinary summer low water between Macon and the mouth of the river.

The estimated cost of the improvement is $210,000.

Prior to improvement navigation was much impeded by rock shoals, sand bars, overhanging trees, snags, and sunken logs, the low-water depth at some places not exceeding 2 feet.

The total amount expended under the present project up to June 30, 1893, including all oustanding liabilities, was $43,782.35, resulting in the removal of 5,305 snags and stumps, and 16,053 overhanging trees; 134 logs were cut up on bank and 125 trees were deadened. Jetties and bank protection have been built at Tillmans Bar. All this work was done by hired labor and purchase of material in open market.

During the fiscal year just closed there have been removed from the channel 1,461 snags and stumps, 4,498 overhanging trees, 573 cubic yards of rocks and loose bowlders, and the wrecks of 3 steamboats; 919 trees were girdled and 58 logs were cut up on bank; 394 pounds of explosives was used.

The total expenditures during the fiscal year ending June 30, 1894, amounted to $10,882.96, and resulted in opening a navigable channel from the river's mouth to Macon.

July 1, 1893, balance unexpended	$11,958.63
June 30, 1894, amount expended during fiscal year	10,882.96
July 1, 1894, balance unexpended	1,075.67
Amount appropriated by act of August 17, 1894	10,000.00
Amount available for fiscal year ending June 30, 1895	11,075.67
Amount (estimated) required for completion of existing project	145,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	50,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

(See Appendix N 7.)

8. *Brunswick Harbor, Georgia.*—The plan of improvement under which operations have been carried on in Brunswick Harbor during the last fiscal year was adopted in 1880, and modified and enlarged in 1886.

The project contemplates the establishment of a navigable channel not less than 15 feet deep at mean low water. The mean rise and fall of tide is 6.8 feet.

The cost of the project of 1880 was estimated at $73,187.50, and as enlarged in 1886, at $190,000, inclusive of appropriations already made.

In 1880, prior to improvement, the channel was not more than 9 feet deep at mean low water.

The amount expended to June 30, 1893, including all outstanding liabilities, was $180,918.92, and has resulted in securing a navigable low-water channel not less than 15 feet deep.

During the fiscal year just closed there were put into the training wall 3,332.46 cubic yards of brush fascines and 780.87 cubic yards of riprap stone. The total expenditures during the fiscal year ending June 30, 1894, amounted to $17,251.13. and resulted in completing the training wall in the harbor.

July 1, 1893, balance unexpended	$17,251.13
June 30, 1894, amount expended during fiscal year	17,251.13
Amount appropriated by act of August 17, 1894	10,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896, for maintenance	10,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

(See Appendix N 8.)

9. *Brunswick Outer Bar, Georgia.*—The act of Congress approved July 27, 1892, provided for payments to Mr. C. P. Goodyear, upon his

procuring a channel of certain widths and depths within periods specified across the outer bar at Brunswick, Ga., north of the present channel, by the explosion of dynamite on or beneath the bottom of the channel. The examinations made by the local engineer showed that the depths, 22 and 23 feet, required by the act to be obtained by November 1, 1892, and January 1, 1893, were not secured. By act of March 1, 1893, the time for procuring the various channel depths was extended to November 1, 1893. An examination made by the local engineer in November, 1893, showed that the depth of 22 feet required by the act to be obtained by November 1, 1893, had not been secured. Correspondence in the matter and the reports of the local officer upon the inspection of the work done are submitted.

(See Appendix N 9.)

10. Jekyl Creek, Georgia.—The plan of improvement under which operations have been carried on in Jekyl Creek during the last fiscal year was adopted in 1888. The project contemplates the establishment of a navigable channel through the creek 7 feet deep at mean low water. The mean rise and fall of the tide is about 7.1 feet.

The estimated cost of the improvement is $38,590.

Prior to improvement the low-water depth at some places did not exceed 3 feet.

The total amount expended to June 30, 1893, including all outstanding liabilities, was $34,748.77, of which $19,811.08 were on account of the appropriation for the improvement of Jekyl Creek.

The total expenditures during the fiscal year just closed amounted to $3,822.20.

The navigable depth over the bar at the mouth of Jekyl Creek is now 5 feet.

July 1, 1893, balance unexpended	$3,822.20
June 30, 1894, amount expended during fiscal year	3,822.20
Amount appropriated by act of August 17, 1894	4,000.00
Amount (estimated) required for completion of existing project	14,590.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	14,590.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix N 10.)

11. Cumberland Sound, Georgia.—The plan of improvement under which operations have been carried on at Cumberland Sound during the last fiscal year was adopted in 1879, and revised in 1891. The project contemplates the establishment of a navigable channel across the bar 19 feet deep at mean low water. The mean rise and fall of tide is 5.9 feet. The estimated cost of the improvement is $2,079,500, exclusive of the work done prior to 1891.

Prior to improvement the low-water depth of the entrance varied from 11 to 12.5 feet, with a mean rise and fall of tide of 5.9 feet.

The total amount expended under the present project up to June 30, 1893, including all outstanding liabilities, was $761,914.92.

The expenditures during the fiscal year just closed amounted to $755.27.

The navigable depth over the bar at present is somewhat more than 14 feet at mean low water.

July 1, 1893, balance unexpended	$755.27
June 30, 1894, amount expended during fiscal year	755.27
Amount appropriated by act of August 17, 1894	170,000.00

Amount (estimated) required for completion of existing project	$1,647,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	1,000,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix N 11.)

12. Inside water route between Savannah, Ga., and Fernandina, Fla.—The existing project of improvement, submitted in report of survey dated November 25, 1891, provides for the establishment of a channel 7 feet deep at mean low water between Savannah, Ga., and Fernandina, Fla.

The estimated cost of the improvement is $105,000, provided that amount may be made at once available.

An appropriation of $15,000, the first for this work, was made by the river and harbor act approved July 13, 1892.

In its present condition the channel depth is less than 5 feet in some places.

The work has so far been entirely confined to the mouth of Jekyl Creek, where the depth across the bar now is 5 feet as against 4.08 feet before its improvement.

The total amount expended up to June 30, 1893, including all outstanding liabilities, was $14,937.69.

The expenditures during the fiscal year just closed amounted to $14,653.31.

July 1, 1893, balance unexpended	$14,653.31
June 30, 1894, amount expended during fiscal year	14,653.31
Amount appropriated by act of August 17, 1894	20,000.00

Amount (estimated) required for completion of existing project	70,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	70,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix N 12.)

13. Removing sunken vessels or craft obstructing or endangering navigation.—The wreck of the Austrian bark *Undine* was removed from Savannah Harbor during the past fiscal year. The work of removing by hired labor four other wrecks from Savannah Harbor has been begun, but has not yet been completed. The total expenditure during the year on removing sunken vessels is $8,418.97.

(See Appendix N 13.)

IMPROVEMENT OF RIVERS AND HARBORS IN FLORIDA.

This district was in the temporary charge of Lieut. Albert M. D'Armit, Corps of Engineers, to May 15, 1894, and in the charge of Maj. Thomas H. Handbury, Corps of Engineers, with Lieutenant D'Armit under his immediate orders since that date; Division Engineer, Col. William P. Craighill, Corps of Engineers.

1. St. Johns River, Florida.—Operations for the improvement of this river have been carried on in conformity with a project submitted in 1879, by the late Col. Q. A. Gillmore, Corps of Engineers. The plan contemplates the formation of a continuous channel, 15 feet deep at mean low water, from Jacksonville to the ocean. The points where work is required are in a reach near Dames Point, 12 miles from the mouth, and on the bar at the mouth. Near Dames Point the mean low-water depth varies from 12 to 13 feet, with a tidal range of about 2 feet.

The bar at the mouth is formed of sand. Before work was begun the mean low water channel depth across it varied from 5 to 7 feet, with a tidal range of 5.8 feet. The channel across the bar shifted continuously north and south through a mile range. The work was divided into two parts: (1) The formation of a channel across the bar at the mouth, by the concentration and direction of the tidal currents by two jetties to start from the opposite shores of the entrance, and to converge until on the bar their outer ends should be approximately parallel and 1,600 feet apart; and (2) the improvement of the Dames Point Reach by dredging, and the construction of works of protection, under a project approved June 11, 1891, and approved in a modified form March 28, 1892.

It was estimated that the cost of obtaining a channel over the bar 15 feet in depth at mean low water by this project would be $1,306,409, and improving the river in accordance with the approved modified project, which contemplated a navigable channel having a depth at low water of 18 feet from inside the bar to Jacksonville, would be $324,000.

The aggregate of the appropriations made for this work since the adoption of the present project is $1,417,000, all of which has been made applicable to the improvement of the bar.

The amount expended up to June 30, 1893 was $1,030,488.05.

The act of July 13, 1892, authorized a contract to be made for the completion of the work at the mouth of the river, the amount of the contract not to exceed $397,000. The sundry civil act approved March 3,1893, contained the item of $284,500 for completing the work.

The increased cost of the work over the original estimate is $110,591. This is attributable to the fact that for many years, during the early part of its progress, long and frequent intermissions were made necessary by reason of a want of adequate appropriations for carrying on a work of this magnitude. Under these circumstances favorable contracts could not be made and the uncompleted work was subject to great deterioration during these suspensions.

From the year 1865 to the adoption of the project in 1879, a sum aggregating $57,476.38 had been expended in dredging for temporary improvement of the bar channel. For making preliminary surveys and preparing the project the sum of $2,523.74 was expended.

Under the provisions of the contract entered into with I. H. Hathaway & Co., under date of November 30, 1892, there were placed upon the south jetty 3,920.6 tons of first-class stone, 24,167.8 tons of second-class stone, and 41,030.5 tons of third-class stone.

The foundation course of matting for the south jetty was extended during the year from station 9498 to station 10712, a distance of 1,214 feet, making the total length of this jetty 11,192 feet. This includes the shore approach of 480 feet. In matting the foundation for the year, 15,673 square yards of mattress work was used.

No work was done on the north jetty during the year.

For the purpose of ascertaining the condition of the channel over the bar, and the effect of the work being done, monthly hydrographic surveys have been made.

The work of closing the sailing gap in the south jetty through which vessels passed out and in, finding a little better water by that course than directly out between the jetties, was commenced June 11. A large body of water was passing out during ebb tide through this opening. It was deemed advisable to direct this upon the bar and transfer its erosive effect to that channel.

South Jetty.—The foundation of this jetty is now at station 10712, which is as far out as it is at present contemplated to extend it. At this point it now rests on the outer slope of the bar in 24 feet of water.

The crest of the jetty from station 1500 back to the shore, slopes from mean low to mean high water. From station 1500 to 3500 it is at mean low water; thence to station 7000 it will average about 2 feet below low-water line. From 7000 to 7500 it is 5 feet below; and from thence to about 8500 it is near the mean high-water line; from thence to about 10300 it is 1 foot below mean low water; thence it slopes off rapidly to the bottom at the end of the foundation. It is proposed to raise this jetty throughout to about the mean high-water line, with the expectation that with the settling and the adjustment of its material under the action of the waves it will finally rest about 3 feet above mean low water.

North Jetty.—No work has been done on this jetty since December, 1891. Its foundation at that time was out as far as station 10934. It is not contemplated at this time to extend this further. The crest of this jetty from the shore end out to station 7000 is now at mean low water. From this station to station 8500 it will average 2 feet below low water, and from station 8500 to the end the average is 6 feet. Until the south jetty has been raised to its full height, and the effect produced carefully observed, it can not be definitely determined what further work, if any, will be necessary upon the north jetty.

During the last week in June a careful survey was made of the bar and its vicinity for the purposes of this annual report. Comparing this with a similar survey made the preceding June, marked change, due to the jetties, will be observed.

The south jetty has in the meantime been extended 1,200 feet. The crest of the bar has moved out 400 feet. The 30-foot curve has remained practically the same. The outer 24-foot curve has advanced about 200 feet, and the 15 and 18-foot curves about the same distance. The area between the outer ends of the jetties and the deep water has been materially deepened. The average over the whole is probably not less than 2 feet. The deepest water over the bar at mean low water last year did not exceed 7 feet. This year we find 11 feet. The 15-foot curve on the inside, between the jetties, has advanced 500 feet, while the 18-foot curve has gone forward but 200 feet.

This comparison shows very encouraging results and gives every assurance of the ultimate success of the works. Had it been practicable to have closed the sailing gap in the south jetty earlier in the season, there is no doubt but there would now be a better straight-out channel between the jetties. This was left open until the last moment because of the better water found on the south side of the south jetty, which pilots wished to take advantage of and for the convenience of the contractor in moving his boats about the work.

Improvement of the river between the bar and Jacksonville, Fla.—The project of 1879, as stated above, provided for the improvement of this portion of the river so as to give a navigable ship channel at low water nowhere less than 15 feet. At the instance of the citizens of Jacksonville a project, with estimate of cost, was prepared, which provided for a navigable ship channel having a low-water depth of 18 feet from the bar to that city. The cost of carrying this project into execution was estimated at $324,000. The citizens of Duval County, Fla., in which Jacksonville is situated, realizing the immense advantage that this depth of water would be to their commerce and to the development of the resources of their State, by permission of their State legislature, determined to bond their county to the extent of $300,000 for the purpose of at once carrying this project into execution. The act of the State legislature provided that this matter should be under the control of a board of trustees.

On March 28, 1892, the project for the improvement was approved by the Secretary of War; and under necessary restrictions and regulations these trustees were permitted to proceed with the work.

The operations of the board of trustees extended from Dames Point to Mile Point, a distance of 10 miles, measured on the channel line, and includes all those portions of the river between the bar and Jacksonville in which a navigable channel with a depth of 18 feet at low water could not be found.

The work was commenced in July, 1892, and finished by the end of May, 1894. During this time this board of trustees did work represented by 19,265 feet of training walls, shore protection, and dams; and 736,291 cubic yards of dredged material, at a total cost of $298,949.29; and resulting in a practical ship channel from Jacksonville to the bar at the mouth of the river nowhere less than 18 feet at mean low water.

July 1, 1893, balance unexpended	$386,541.95
June 30, 1894, amount expended during fiscal year	147,338.43
July 1, 1894, balance unexpended	239,203.52
July 1, 1894, amount covered by uncompleted contracts	215,542.48
July 1, 1894, balance available	23,661.04

(See Appendix O 1.)

2. *Upper St. Johns River, Florida.*—By the river and harbor act of July 5, 1884, the sum of $5,000 was appropriated for improving the Upper St. Johns River, Florida, this being the first appropriation made for this work.

The stream has sufficient depth for the class of vessels adapted to its navigation, but is very crooked.

The approved project of 1883 was to establish a straighter channel by suitable cut-offs, to be made 6 feet deep at low-water stage and 100 feet wide at the bottom, at an estimated cost of $38,800.

The work was advertised, but no bids were received on account of the small sum appropriated, and operations were deferred until further appropriations might be available.

On April 2, 1892, the original project was modified so that the money available might be expended in removing the worst points at the bends where cut-offs had been proposed.

A contract was let for the work and operations began March 16, 1893. The plant provided by the contractors has proven inadequate, and only 2,006.7 cubic yards had been removed up to the end of June, 1893.

Work under the above contract was continued into the present fiscal year. It resulted in the removal of 9,397.5 cubic yards of material (place measurement) and a consequent improvement of the channel around the bends. The channel of the entire upper river is now fairly navigable with the exception of one bend, known as the Revolving Bend, where no work has been done, as it is proposed to make a cut-off at this point as soon as funds become available. The material excavated was pumped back on shore, behind suitable retaining walls, is rapidly becoming covered with vegetation, and presents a reasonable assurance of permanency.

Available funds were exhausted October 14, and the dredge was moved to Volusia Bar for work at that point.

The amount expended up to June 30, 1893, was $455.20.

It is recommended that Congress be asked to appropriate $5,000 for continuing this improvement.

July 1, 1893, balance unexpended	$4,544.80
June 30, 1894, amount expended during fiscal year	4,240.51
July 1, 1894, balance unexpended	304.29
Amount (estimated) required for completion of existing project	33,800.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	5,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

(See Appendix O 2.)

3. *Volusia Bar, Florida.*—Volusia Bar is located at the south end or head of Lake George, about 162 miles by river from the mouth of St. Johns River, at the point where the waters of the river flow into the lake.

An examination of Volusia Bar with a view to its improvement was made in March, 1879.

Before its improvement the channel over the bar was very crooked, and had a least depth varying from 3½ to 4½ feet.

The approved project is to establish and maintain a channel 6 feet deep across the bar by the increased velocity of flow produced by two converging jetties of brush and stone, assisted by dredging, if necessary, and to define and protect the channel thus formed by rows of fender piles. In 1887 this project was modified to limit the depth to the 5 feet already attained, as that depth is sufficient for the steamers navigating the Upper St. Johns River, and is as great as can be carried over the bars between Lake Monroe and Lake George.

The aggregate of the appropriations for this work is $27,000.

The amount expended up to June 30, 1893, was $25,937.54.

Two jetties have been built, starting from opposite sides of the river bank at the south edge of the lake and converging until on the bar the clear channel way between them was 230 feet wide. The east jetty is 3,400 feet long, and is built to the level of mean low water. Two rows of fimly set piles provided with waling strips confine boats to a 100-foot channel across the crest of the bar. In 1887 the depth attained was reported to be ample for the existing commerce.

With the $1,000 appropriated July 13, 1892, repairs have been made to the fender piles at a cost of $225. Under contract with the same parties, Messrs. Marzyck & Browne, of Jacksonville, Fla., dredging was begun and finished in November, 1893. A total of 257.7 cubic yards of material, measured in place, was removed, making a cut 50 feet wide and 310 feet long, having a depth of 6 feet. Since the completion of this cut no complaints have been received.

A careful survey of this bar, made in May, 1894, shows a good steamboat channel through it, having a depth of practically 6 feet at extreme low water. During high water of the St. Johns River some sediment is brought down. Upon reaching the wide portion of its bed at this place it is deposited. If the fall is sudden this will interfere with navigation to a limited extent until the current has time to scour a channel through it.

An annual appropriation of $1,000 will be sufficient to repair the jetties and keep this bar in good navigable condition at all times.

July 1, 1893, balance unexpended	$1,062.46
June 30, 1894, amount expended during fiscal year	829.05
July 1, 1894, balance unexpended	233.41
Amount appropriated by act of August 17, 1894	1,000.00
Amount available for fiscal year ending June 30, 1895	1,233.41
Amount that can be profitably expended in fiscal year ending June 30, 1896	1,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix O 3.)

4. *Ocklawaha River, Florida.*—The portion of the Ocklawaha River which it is proposed to improve lies between Leesburg, on Lake Griffin, and the mouth, a distance of 94 miles. The channel width varies from 30 to 70 feet and the depth from 5 to 9 feet. From the outlet of Lake Griffin for a distance of 28 miles the river is sluggish in current, has numerous bends, and is badly obstructed by floating islands and grass. For the remaining 58 miles the current is strong and the principal obstructions are snags and overhanging trees.

The approved project is to clear the channel between Lake Griffin and the mouth by removing snags and the worst overhanging trees, and by moving the floating islands out of the channel and staking them in place by piles.

The amount appropriated for this improvement up to the close of the fiscal year ending June 30, 1894, was $11,000.

The amount expended up to June 30, 1893, was $10,998.30.

Under the appropriation made by act of September 19, 1890, a survey and map of the river were made and the channel was cleared of its worst obstructions from the mouth to the prairie, a distance of 60 miles. A total of 3,881 snags and 705 overhanging trees were removed, and 84 trees were trimmed.

The unprecedented low water developed a few shoals which it appears desirable to have removed and more effective means being proposed for keeping the channel clear of floating islands. A revised project has been adopted in 1892 calling for an additional expenditure of $15,000. The estimated annual cost for maintenance of the channel is $1,000.

The $1,000 appropriated July 13, 1892, was expended in clearing the river of obstructions. Five hundred and seventy-four snags and 312 overhanging trees were removed, and 14 trees were trimmed. A fairly navigable channel exists at high water as far as the floating islands and at extreme low water as far as the prairie.

July 1, 1893, balance unexpended	$1.70
June 30, 1894, amount expended during fiscal year	1.70
Amount appropriated by act of August 17, 1894	3,000.00
Amount (estimated) required for completion of existing project	12,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	12,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix O 4.)

5. *St. Augustine Harbor, Florida.*—The approved project is to protect the shores on the north and south side of the entrance from erosion, by groins constructed of riprap on brush foundation and capped with concrete.

The aggregate of the appropriations for this work is $65,000

The amount expended up to June 30, 1893 was $56,875.03.

Work was commenced in 1889 and had resulted in the construction of 7 groins, 3 on the north beach, in length 549 feet, 467 feet and 415 feet; and 4 on the south beach, or Anastasia Island, near the lighthouse. These have lengths of 341 feet, 523½ feet, 290 feet, and 220 feet. Where it has been found necessary to protect the roots of them from erosion, wing walls have been built.

Two of these groins, in length 290 feet and 220 feet, with suitable wing walls, were built during the last fiscal year.

This locality was visited by very severe storms last fall, but the erosion of the shores in the vicinity of the groins was effectually checked by them.

July 1, 1893, balance unexpended	$8,124.97
June 30, 1894, amount expended during fiscal year	8,042.51
July 1, 1894, balance unexpended	82.46
Amount appropriated by act of August 17, 1894	6,000.00
Amount available for fiscal year ending June 30, 1895	6,082.46
Amount (estimated) required for completion of existing project	24,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	10,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

(See Appendix O 5.)

6. *Indian River, Florida.*—The total length of this reach of the Indian River is 81 miles. Navigation was formerly interrupted by numerous shoals and bars, having at low water a depth of from 2½ to 4 feet.

It was included in the franchise granted by the State of Florida to the Florida Coast Line Canal and Transportation Company, by which this company was authorized, in consideration of certain improvements to be made by it, to own vessels and navigate this waterway and to levy tolls upon its cuts and improved channels.

A survey and examination with estimate of the cost of the improvement of "Indian River between Titusville and Jupiter Inlet" was provided for in the river and harbor act of 1890.

The report made in compliance with this provision may be found in the Chief of Engineers' report for 1891, page 1673*et seq.* The project therein mentioned provides for making a continuous channel 5 feet deep at low water and at least 75 feet wide in the straight reaches, with as much greater width in the turns as may be required, by widening the cuts of the canal company and making new cuts where needed and by removing some of the mangroves in the narrows. It was estimated that the cost of the proposed work would be, approximately, $44,000.

Prior to this time the Florida Coast Line Canal and Transportation Company, under its charter from the State, dredged a number (23) of cuts across shoals within this reach, making a continuous navigable channel 50 feet wide and 5 feet deep. The aggregate length of these cuts is 39,500 feet.

By act approved July 13, 1892, $15,000 was appropriated for—

> Improving Indian River, Florida, between Goat Creek and Jupiter Inlet: *Provided,* That no part of the money appropriated shall be expended until the Florida Coast Line Canal and Transportation Company surrenders and relinquishes to the United States all the rights and privileges which it now holds under State charter along the entire route.

There has been considerable delay in obtaining the requisite relinquishments from the company required by the provisions of this act. The matter is now settled and the relinquishments have been made in due form to the satisfaction of the United States Attorney-General.

On the first of June some necessary repairs were commenced upon the United States snag and dredge boat *Suwanee*, lying in ordinary at Tampa, Fla., preparatory to taking her around to Indian River for the purpose of dredging, in accordance with the approved project. These repairs were practically completed at the end of the month. The boat will enter the river and commence operations early in July.

It is estimated that $15,000 can be profitably expended during the fiscal year ending June 30, 1896, in carrying out this project.

July 1, 1893, balance unexpended	$15,000.00
June 30, 1894, amount expended during fiscal year	1,169.42
July 1, 1894, balance unexpended	13,830.58
July 1, 1894, outstanding liabilities	1,077.62
July 1, 1894, balance available	12,752.96
Amount appropriated by act of August 17, 1894	5,000.00
Amount available for fiscal year ending June 30, 1895	17,752.96
Amount (estimated) required for completion of existing project	24,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	15,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

(See Appendix O 6.)

7. *Northwest entrance, Key West Harbor, Florida.*—A bar having a channel depth of 10.5 feet obstructs the northern entrance to this harbor. During storms the available depth is so much reduced that vessels bound to and from gulf ports can not use it, but are compelled to make a detour of about 100 miles by Dry Tortugas to enter or leave the gulf.

An examination of the entrance, with a view to its improvement, was made in 1867 and again in 1881. In 1882 Congress made an appropriation of $25,000 for dredging a channel 300 feet wide and 17 feet deep across the bar. As was anticipated, the improvement was only temporary.

In the act approved August 5, 1886, $2,500 was appropriated for a new examination and survey of the bar. This was made in December, 1886, and January, 1887. The bar was found to be formed and maintained by interfering tidal currents. The project for its improvement comprised the construction of one or more training walls, with dredging, if necessary.

In the act of August 11, 1888, Congress appropriated $25,000 for this work, with the proviso that the Secretary of War should appoint a Board of three Engineer Officers, who should consider the subject and report on the advisability of continuing the work under the above project, and that he should submit the report, together with the views of himself thereon, to Congress at its next session.

The final report of the Board was submitted in November, 1889, and printed as part of Appendix P 4, Report of the Chief of Engineers, 1890, pages 1583–1589. The Board was of opinion that the work is of national importance. It recommended that the improvement be begun by the immediate construction of a jetty along the northeast side of the entrance, probably supplemented as the work progresses by a jetty on the western side. The estimated cost of the first jetty was $500,000. The depth of water to be obtained is 17 feet. The aggregate of the appropriations to June 30, 1894, is $115,000.

Under the contract in force at the end of last fiscal year work continued until November 30, 1893, when the contract was completed. A total of 22,434.7 cubic yards of stone and 1,397.8 yards of quarry chips were placed under this contract, making the jetty 11,364 feet long.

The stone used in this work has all been the soft limestone quarried from the keys of the locality, and is so light that it will not stand above from 4 to 5 feet below low water. The jetty having been extended to its full length a portion of the rock was used in widening the base to 50 feet over a part of its length instead of building any higher.

No sinking of the jetty has occurred even where stone has been deposited on a layer of sand overlying the natural rock bottom.

As a result of the jetty, during the early part of the present calendar year a new channel has been formed, which was tried by the steamers of the Plant Steamship Company and found to have better water and to be straighter than the former sailing channel. Its least depth is 12 feet at mean low water, and there is but one turn in the channel.

July 1, 1893, balance unexpended	$67,840.86
June 30, 1894, amount expended during fiscal year	67,444.82
July 1, 1894, balance unexpended	396.04
Amount appropriated by act of August 17, 1894	80,000.00
Amount available for fiscal year ending June 30, 1895	80,396.04
Amount (estimated) required for completion of existing project	305,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	305,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix O 7.)

8. *Caloosahatchee River, Florida.*—Before improvement the lower part of the river was so obstructed by oyster bars that the available channel depth was only 5½ feet. About 17 miles above the mouth the river loses the characteristics of an estuary, and there are numerous islands and a broad shoal.

The project adopted in 1882 called for the formation by dredging of a channel 100 feet wide and 7 feet deep from the bay to Fort Myers, a distance of 17 miles. In 1886 this project was modified so as to include the improvement of the upper river as far as Fort Thompson by removal of snags and overhanging trees, giving a low-water depth of 4 feet for this reach.

The aggregate of the appropriations for this work amounts to $28,600.

The amount expended up to June 30, 1893, was $27,590.11.

The expenditure of this amount has resulted in a channel 6 feet deep and 100 feet wide between the mouth and Fort Myers. A narrow cut 5 feet deep had been made through the shoals at Beautiful Islands and partially protected by a training wall, and the worst obstructions had been removed from the river as far as Fort Thompson.

There is now a clear channel from the mouth to Fort Myers, having a low-water depth of 6 feet, and from there to Fort Thompson 4 feet.

The $1,000 available at the end of the last fiscal year has been expended in clearing the upper river and marking the channel in the lower river. The work was done by the United States snag and dredge boat *Suwanee.* The river is now reported to be in a good navigable condition, and, with an annual appropriation of $1,000, it is believed that it can be kept so.

July 1, 1893, balance unexpended	$1,009.89
June 30, 1894, amount expended during fiscal year	1,002.52
July 1, 1894, balance unexpended	7.37
Amount appropriated by act of August 17, 1894	2,000.00
Amount available for fiscal year ending June 30, 1895	2,007.37

Amount that can be profitably expended in fiscal year ending June 30, 1896	$1,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix O 8.)

9. Charlotte Harbor and Pease Creek, Florida.—The river and harbor act approved September 19, 1890, contained an item for "improving, dredging, and deepening the channel of Charlotte Harbor and Pease Creek, Florida, to the pier at Punta Gorda, the terminus of the Florida Southern Railroad, $35,000."

Under this appropriation a survey of the deep water of the harbor was made from Boca Grande Pass to Punta Gorda. There was found at that time a channel depth of 19 feet at mean low water on the bar at the Pass, 9 feet upon the shoals south of Cape Haze, and 10 feet upon the shoal near the wharves at Punta Gorda. The rise of tide is approximately about 2 feet. An estimate was made for dredging a channel 300 feet wide and 23 feet deep through the bar at Boca Grande Pass. The amount of this was $35,000. A separate estimate was made for forming a channel 200 feet wide and 12 feet deep from the wharves at Punta Gorda to the Pass. The amount of this was $127,500.

Work was inaugurated under the project for the 12-foot channel, estimated to cost $127,500, and the funds expended in dredging the channel near Punta Gorda wharves. The work thus far accomplished has resulted in forming a channel 300 feet wide for a distance of 300 feet in front of the wharves, 160 feet wide for a distance of 4,729 feet, and 120 feet wide for a distance of 1,764 feet, where it connects with the 12-foot contours.

The total length of the dredged cut is 6,793 feet. Over nearly the whole of this length the depth is in excess of 13 feet.

The amount expended up to June 30, 1893, was $23,496.31.

By reason of the early exhaustion of the appropriation for this work, no dredging was done during the fiscal year ending June 30, 1894.

A survey of the shoal north of Cape Haze was made in May for the purpose of determining the best location in which to develop the 12-foot channel over these shoals when additional funds are made available for the work.

July 1, 1893, balance unexpended	$11,503.69
June 30, 1894, amount expended during fiscal year	11,154.39
July 1, 1894, balance unexpended	349.30
Amount appropriated by act of August 17, 1894	20,000.00
Amount available for fiscal year ending June 30, 1895	20,349.30
Amount (estimated) required for completion of existing project	72,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	35,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix O 9.)

10. Sarasota Bay, Florida.—An examination and survey of this bay was made in 1889. An appropriation of $5,000 was made in the act approved September 19, 1890, for "improving Sarasota Bay from Tampa Bay to Sarasota, Florida."

A navigable channel with a minimum depth of 5 feet extends throughout the length of Big Sarasota Bay, excepting in two reaches, Palma Sola Pass and Long Bar, which have a total length of 5,400 feet. In these reaches the available depth was 4.3 and 3.5 feet, respectively. The tidal range in the bay is 1.5 feet.

The present approved project calls for the formation of a continuous channel 100 feet wide and 5 feet deep at mean low water from Tampa Bay to the town of Sarasota, Fla., a distance of 21¼ miles, at an estimated cost of $17,500.

The total amount appropriated for this work is $7,500.

With this amount dredging has been done upon the Palma Sola shoal which has resulted in connecting the 5-foot contours by a cut 2,292 feet long, of which a length of 1,673 feet is 38 feet wide, with a depth of 6 feet, while the remaining 619 feet of the cut is 40 feet wide and from 5 to 6 feet deep. A total amount of 6,456.5 cubic yards of sand and shell (measured in place) has been removed. The last examination shows that this cut has not filled in.

July 1, 1893, balance unexpended	$577.38
June 30, 1894, amount expended during fiscal year	525.21
July 1, 1894, balance unexpended	52.17
Amount appropriated by act of August 17, 1894	2,500.00
Amount available for fiscal year ending June 30, 1895	2,552.17
Amount (estimated) required for completion of existing project	7,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	7,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix O 10.)

11. *Manatee River, Florida.*—The portion of the Manatee River under improvement is the lower reach, between Rocky Bluff and the mouth, a distance of about 12 miles. This had a mid-channel depth of from 7 to 20 feet. The general width is about three-fourths of a mile. At the mouth was a shoal with a minimum depth of 7 feet. Between Palmetto and Manatee, about 6 miles from the mouth, was another bar covered by from 3 to 5 feet of water.

The river was examined in 1881. The project adopted had for its object the formation of a channel 100 feet wide and 13 feet deep at mean low water from Tampa Bay to McNeil Point (Palma Sola). Owing to the changed commercial relations since the adoption of the project, brought about by the extension of the railroad to Tampa, the transfer to Tampa of the principal gulf steamship lines, and the service of the smaller towns around Tampa Bay by coasting steamers from Tampa, the project was modified in 1886 to provide for the passage of these lighter draft vessels to all of the towns of the lower river by the removal of the bar above Palmetto.

The amount expended up to June 30, 1893, was $35,552.71.

A dredged cut was made across the bar at the mouth of the river, another cut was made across the bar between Manatee and Braidentown, and a survey and map of the river were made. The cut at the mouth had been nearly obliterated, but a channel 8 feet deep and of sufficient width existed from Tampa Bay to Manatee. By act of September, 19, 1890, $6,000 was appropriated for continuing the improvement, which amount was supplemented by a further appropriation of $6,000, made by act of July 13, 1892. With the $12,000 thus available, extensive repairs were made to the United States steam snag and dredge boat *Suwanee*, with a view of better adapting it to this work. It was proposed to dredge a channel 12 feet deep at mean low water and 100 feet wide through the bulkhead at Sneads Point. Work was begun in June, 1893. One thousand three hundred and eighty-nine cubic yards (measured in place) was removed during that month. This work was continued until completion in September, 1893, resulting in a total of 22,300 cubic yards excavated. A channel was formed through the bulkhead 80 feet wide and 12 feet deep at mean low water.

July 1, 1893, balance unexpended	$4,447.29
June 30, 1894, amount expended during fiscal year	4,390.66
July 1, 1894, balance unexpended	56.63
Amount appropriated by act of August 17, 1894	3,000.00
Amount available for fiscal year ending June 30, 1895	3,056.63
Amount (estimated) required for completion of existing project	30,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	15,000.00
Submitted in compliance with requirements of sections 2 of river and harbors acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix O 11.)

12. Tampa Bay, Florida.—An examination of this bay with a view to its improvement was made in 1879. A navigable depth of 7 feet at low water at that time prevailed from Tampa to the bay and from there to the gulf only 12 feet could be carried. The approved project at that time adopted was to deepen and widen the channel from Tampa to the bay, a distance of 5¾ miles, by dredging and rock excavation, so as to give a clear depth of 9 feet at mean low water, with a width in the river of 200 feet and in the bay of 150 feet. The estimated cost of this improvement was $97,000.

In 1888 this project was modified so as to provide for a channel 8 feet deep in Hillsboro Bay and Hillsboro River to the city of Tampa, and a channel 200 feet wide and 20 feet deep at mean low water from the gulf to Port Tampa, a town situated near the mouth of old Tampa Bay and about 9½ miles from Tampa. It was estimated at that time that the completion of the project as modified would cost $35,000.

The amount expended up to June 30, 1893, was $126,774.61.

All the funds required by the original and modified projects have been provided.

The Port Tampa channel was completed March 28, 1891, at which time its condition was as follows:

The cut at the entrance had a mean low-water depth of 20 feet, with a width of 115 feet for one-half its length and of 100 feet for the remaining distance, with an additional width of 75 feet the entire length, having a mean low-water depth of 19.7 feet. The tidal range is 1.5 feet. Since that date no apparent change has taken place in the channel.

Work in the Hillsboro Bay channel was stopped June 3, 1893, at which time the channel was 200 feet wide in the mouth of Hillsboro River and from 75 to 100 feet wide in the bay, with a depth of from 8 to 9 feet throughout. This condition is unchanged.

July 1, 1893, balance unexpended	$3,225.39
June 30, 1894, amount expended during fiscal year	3,223.52
July 1, 1894, balance unexpended	1.87

(See Appendix O 12.)

13. Withlacoochee River, Florida.—This river is 120 miles long and has a normal width varying from 75 to 180 feet, though at numerous points a defined channel is almost lost in broad marshy lakes and cypress swamps. The low-water depth varied from 1 to 7½ feet. Before improvement the river was so obstructed by shoals, loose rocks, snags, fallen trees, floating grass islands, and bars as to be practically impassable, excepting in isolated reaches.

The river was examined with a view to its improvement in 1879. The approved project calls for the removal of snags, overhanging trees, loose rocks, and some of the worst shoals between the Gulf of Mexico and Pemberton Ferry, a distance of about 77 miles, so as to permit boats of 2 feet draft to navigate the river during one-half the year.

Prior to June 30, 1891, the river had been cleared and made navigable, as called for by the project, between Pemberton Ferry and Dunnellon. Work was still required on some of the ledges in order to make navigation safe. Work was also required below Dunnellon.

The amount appropriated is $23,900. The amount expended up to June 30, 1893, was $23,888.55.

In the act approved September 19, 1890, $5,400 was appropriated for continuing the improvement. Work under this appropriation was begun March 23, 1892. On account of the very low stage of the river the United States snag and dredge boat *Suwanee* could not be taken up where the work was most required. The boat was laid up and a party formed from the crew, and the work of removing obstructions was carried on from the small boats and from the banks. Operations were continued during 1893 until the money available was exhausted.

No work was done during the fiscal year ending June 30, 1894. The channel is now practically clear from Pemberton Ferry to the mouth.

July 1, 1893, balance unexpended	$11.45
June 30, 1894, amount expended during fiscal year	1.53
July 1, 1894, balance unexpended	9.92
Amount appropriated by act of August 17, 1894	800.00
Amount available for fiscal year ending June 30, 1895	809.92
Amount that can be profitably expended in fiscal year ending June 30, 1896	800.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

(See Appendix O 13.)

14. Harbor at Cedar Keys, Florida.—The improvement of this harbor has been carried on from time to time under various appropriations made since 1872. It was obstructed by a shoal, known as the middle ground, lying in the main ship channel opposite War Key, and by shoals elsewhere in the channel and at its outer extremity. At these points the general channel depth of 12 feet was reduced from 7 to 9 feet by outcropping rocks with sand and shells.

The existing project for the improvement has for its object the formation of a channel 200 feet wide and 10½ feet deep through these shoals. Work under this project has been carried on under appropriations since 1884. The amount appropriated for this project is $22,000.

The amount expended up to June 30, 1893, was $21,988.70.

A clear channel of the required depth from the gulf up to Cedar Keys has been obtained. Near Buoy No. 12 and in the middle ground the width was insufficient. Some further dredging was done in the middle ground. When work stopped the cut there had a width of 200 feet and a least depth of 9½ feet. Along its east side the depth was 10 feet.

In the act approved September 19, 1890, $2,500 was appropriated for this harbor, with the provision that a portion could be expended at Derrick Island Gap on the inside channel from Suwanee River. The project for this portion of the improvement is to obtain a channel 5 feet deep at mean low water from the harbor of Cedar Keys to the Suwanee Basin.

The work was done with the United States steam snag and dredge boat *Suwanee*. When operations ceased, owing to the exhaustion of the appropriation, a channel had been dredged in the vicinity of Derrick Island Gap 1,196 feet long, 37½ feet wide, and 6 feet deep.

There were no operations during the past fiscal year, no funds being available, and further appropriations are not at present recommended, the present commercial requirements being fully met by the existing condition of the harbor, excepting as far as the inside passage between the town of Cedar Keys and the mouth of the Suwanee River is concerned, the channel in the vicinity of Derrick Island Gap being still incomplete.

July 1, 1893, balance unexpended	$11.30
June 30, 1894, amount expended during fiscal year	11.30
Amount (estimated) required for completion of existing project	44,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix O 14.)

15. *Suwanee River, Florida.*—The project for the improvement of the Suwanee River was adopted in 1879. The reach of the river covered by the project extended from Ellaville to its mouth in the Gulf of Mexico, a distance of 130 miles. At that time the obstructions in this portion of the river consisted of shoals, composed of soft, unstratified limestone, mixed with flint, extending partly or entirely across the river, in some places covered with shallow deposits of sand and in others bare; also snags and overhanging trees. The channels across these shoals were often narrow and very crooked. Their depth at mean low water would vary from 15 inches to 3 feet. At places large isolated limestone bowlders in the channel were constant sources of danger to navigation.

An examination of the river with a view to its improvement was made in 1879. The proposed improvement consists in deepening the bar at the passes by dredging, the removal of snags and overhanging trees along the river, and deepening and improving the channel at various places by the removal of rocks and snags, and the construction of wing dams, so as to straighten, widen, and deepen the channel. The depth to be obtained is 5 feet through the bars at the passes for a width of 150 feet and up the river as far as New Branford, a distance of 80 miles. From there to Ellaville, a distance of 50 miles, the depth is to be 4 feet and the width 60 feet.

The aggregate of the amounts appropriated is $44,000.

The amount expended up to the close of the fiscal year ending June 30, 1893, was $42,837.31.

The act of 1888 provided that $10,000 of the amount appropriated "be expended in the purchase or construction of a suitable steam snag boat, with dredging and pile-driving machinery, to be used on the rivers of the west coast of Florida." Of the total appropriated, $34,000 has therefore been available for work under the project.

With this amount a navigable depth of 5 feet at low water has been obtained from New Branford up as far as Hudson—about 10 miles below Ellaville.

Work under the appropriation of July 13, 1892, was begun November 14 and suspended because of exhaustion of funds on November 29, 1893. The work was done by the United States steam snag and dredge boat *Suwanee*. Five large snags and 2,873.1 cubic yards of material were removed and 10 channel stakes established. Of the material dredged, 1,696.4 cubic yards was removed from Derrick Gap, making two cuts, one 420 feet long and 41 feet wide (excepting for 100 feet, where it is 82 feet wide) and the other 125 feet long and 41 feet wide, the whole having a uniform depth of 5 feet at mean low water. One thousand one hundred and seventy-six and seven-tenths cubic yards was removed from the mouth of the river, making a cut 375 feet long and 41 feet wide with a depth of water varying from 5½ to 6 feet at mean low water. All the shoals where dredging was required to enable boats to cross at extreme low water have been removed and the channel from North Key Shoal to Suwanee River plainly marked with palmetto cluster and single stakes.

July 1, 1893, balance unexpended	$1,357.89
June 30, 1894, amount expended during fiscal year	1,323.19
July 1, 1894, balance unexpended	34.70
Amount appropriated by act of August 17, 1894	3,000.00
Amount available for fiscal year ending June 30, 1895	3,034.70
Amount (estimated) required for completion of existing project	18,158.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix O 15.)

IMPROVEMENT OF RIVERS AND HARBORS IN WESTERN GEORGIA AND FLORIDA AND IN EASTERN ALABAMA.

This district was in the charge of Capt. Philip M. Price, Corps of Engineers, to March 3, 1894, and of Maj. F. A. Mahan, Corps of Engineers, since that date, having under their immediate orders Lieut. William E. Craighill, Corps of Engineers, to November 14, 1893, and Lieut. Charles Keller, Corps of Engineers, since that date; Division Engineer, Col. C. B. Comstock, Corps of Engineers.

1. Apalachicola Bay, Florida.—In 1879 there was a minimum depth of 3.5 feet in the channel over the bar at the mouth of the Apalachicola River.

The bar begins about one-half mile below the town of Apalachicola, Fla., and is about 7,300 feet wide between the 8-foot curves.

In 1879 a plan of improvement was adopted which contemplated dredging through the bar a straight channel 11 feet deep and 100 feet wide, to be afterwards increased to 200 feet should the first cut produce results to warrant it.

In 1891 this project was amended to include dredging a straight channel through Bulkhead Shoal 9 feet deep and not less than 100 feet wide.

Up to June 30, 1893, the sum of $126,828.61 had been expended on this improvement in dredging a straight channel through the bar at the mouth of the Apalachicola River at various times since 1881, and in dredging a channel about 4,000 feet long, 120 feet wide, and 9 feet in depth across the Bulkhead Shoal in 1891–'92. With the appropriations available the dredged cut through the bar had never exceeded 90 feet in width and 9.5 feet in depth, and had gradually filled up after each dredging, partly by the deposit of silt from the river and partly by the washing in of material from the sides of the cut. Between November, 1892, and April, 1893, a cut 5,600 feet long, from 70 to 120 feet wide, and 8 feet deep, was made through the bar at the mouth of the Apalachicola River.

No change in the cut through Bulkhead Shoal is reported. This shows, apparently, that this channel is fairly permanent. Longer experience shows that dredging to the amount of 60,000 or 70,000 cubic yards will be required every year to keep open the bar at the mouth of the Apalachicola River. A wider and deeper channel, which could be had for about $50,000, might be more permanent.

The commerce of Apalachicola Bay consists mainly in the exportation of lumber, which is transported from the mainland to the anchorage grounds in lighters and rafts, towed by tugs drawing from 5 to 7 feet of water. When the depth in the channel across the bar is reduced below 7 feet much trouble is experienced in carrying on the business of the port.

July 1, 1893, balance unexpended	$171.64
June 30, 1894, amount expended during fiscal year	79.83
July 1, 1894, balance unexpended	91.81
July 1, 1894, outstanding liabilities	9.54
July 1, 1894, balance available	82.27
Amount appropriated by act of August 17, 1894	15,000.00
Amount available for fiscal year ending June 30, 1895	15,082.27
Amount that can be profitably expended in fiscal year ending June 30, 1896 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	50,000.00

(See Appendix P 1.)

2. *Apalachicola River, the Cut-off, and Lower Chipola River, Florida.*—The examination and survey of the Apalachicola River, finished in 1873, showed that the river, throughout its length of 105 miles, had a channel not less than 6 feet deep. The channel was, however, much obstructed by the accumulation of logs and snags brought into it by the freshets in the Chattahoochee and Flint rivers and by the trees which had fallen from its own heavily timbered banks. At Moccasin Slough the river had been obstructed by piles driven by Confederate authorities during the war. Drift had accumulated against these piles, forming a dam across the river, which had then forced a narrow and very crooked channel through its banks and into the river Styx. Navigation was difficult at the upper and lower Elbows on account of the abrupt bends and narrow channel.

The original project for the improvement of the river provided for securing a channel 100 feet wide and 6 feet deep, by the removal of snags and overhanging trees and widening and straightening the channel at Moccasin Slough and the Elbows, at an estimated cost of $80,333.

In conformity with the act of September 19, 1890, this project was in that year modified by adding thereto the securing of a channel 60 feet wide and 5 feet deep through the Cut-off, Lee Slough, and the Lower Chipola River, at an estimated cost of $7,500.

The expenditure between 1874 and June 30, 1893, of $49,565.90 had resulted in clearing out the great accumulation of logs and snags and overhanging trees which originally obstructed the Apalachicola River, and in annually removing the new logs and snags brought in by the winter freshets.

A partial improvement had also been effected at Moccasin Slough and the Elbows, but navigation at these points was still difficult. A large quantity of drift and many overhanging trees were removed from the Cut-off and the Lower Chipola River, and steamboats were enabled to reach the landings above and below Lee Slough, through which steamboat navigation was completely obstructed by drift, sunken logs, and trees.

During 1893 many snags, sunken logs, and overhanging trees were removed from the Apalachicola River, the Cut-off, and Lower Chipola River, and a practicable but narrow and crooked channel was opened through Lee Slough. Steamboats can now, with some difficulty, pass through the Cut-off, Lee Slough, and Lower Chipola River on the upstream passage. These waterways afforded the only practicable means of transportation for the products of this section of country, which is being rapidly settled by fruit-growers, and it is very desirable that a sufficient appropriation shall be made to enable a safe channel to be opened through Lee Slough.

There having been no funds available, no work was done during the past fiscal year. The condition of the improvement is about as reported June 30, 1893.

The Cut-off is a navigable waterway about 3 miles long, connecting the Apalachicola River with the Lower Chipola River near the Dead Lakes. The Chipola River empties into the Apalachicola River about 14 miles below its junction with the Cut-off. "Lee Slough" is simply a local name for a portion of the Lower Chipola River, about 3 miles long (see map at page 1697 of the Annual Report of the Chief of Engineers for 1891). It is therefore suggested that the wording of the next appropriation for this river be changed from "Apalachicola River, including Lee Slough," to "Apalachicola River, including the Cut-off and Lower Chipola River," in order that the work required to be done may be correctly designated.

Amount appropriated by act of August 17, 1894	$5,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	11,000.00

(See Appendix P 2.)

3. *Flint River, Georgia.*—Before the improvement was begun the river was only navigable at low water from its junction with the Chattahoochee River up to Bainbridge, and the channel over this portion was narrow, crooked, and much obstructed by logs, snags, and overhanging trees.

The present project for the improvement of this river was adopted in 1873 and modified in 1879, the object of the original project being to afford a channel 100 feet wide and 3 feet deep at low water, from its mouth up to Albany, Ga., an estimated distance of 105 miles, and of the modification to provide a navigable channel for light-draft steamers at moderate stages of water, from Albany to Montezuma, an estimated distance of 77 miles.

Previous to the act of June 18, 1878, $70,000 was appropriated for the "Chattahoochee and Flint rivers," of which $18,000 was expended on the Flint River.

The expenditure up to June 30, 1893, was $180,423.18.

Above Albany the channel had been partially cleared of logs and snags and overhanging trees, and to a limited extent of loose rock.

Below Albany some loose rock excavation had been done at all the shoals between Albany and Bainbridge. There was a completed and permanent channel from Albany to Newton, 33¼ miles. From Newton to Bainbridge, 21 miles, the channel was passable, with care, at moderate stages of water, but it was impracticable at many places during low water. From Bainbridge to the mouth of the river, 36 miles, the river was navigable throughout the year, and required but little improvement aside from the removal of drift logs and snags brought in by the winter floods.

During the fiscal year ending June 30, 1894, $7,560.76 was expended in removing rock bowlders and snags from the bed of the river and in altering and improving the snag boat.

Between the mouth of the river and Bainbridge, Ga., an estimated distance of 36 miles, the river is in fairly good condition, and requires little more than the annual clearing of snags and drift brought in by the winter freshets. On this portion of the river many steamboats plying on the Chattahoochee and Apalachicola rivers make regular trips and do a large business, and the maintenance of the navigation is therefore of great commercial benefit.

Between Bainbridge and Albany, Ga., an estimated distance of 65 miles, the improvement consists mainly in excavating a channel through the many rock shoals and reefs and in depositing the excavated material in spur dams. The improvement, when completed, will be of a permanent character, but for its preservation and for the annual removal of the snags and drift it will be necessary to maintain a snag boat on the river, at an estimated cost of $6,000. A considerable river trade had been developed on this section of the river in consequence of the improvements already effected. The business will probably be much increased as low-water navigation is facilitated by further work.

Above Albany, for a distance of 38 miles, to Warwick, Ga., low-water navigation is prevented by a series of rock shoals, on which the low-water depth varies from 6 to 18 inches. The loose bowlders have been partially removed from the channel on this portion of the river. Experience in the work shows that a practicable and useful navigation of this portion of the river at moderate stages of water can probably be secured only by providing slack-water navigation, by the construction of locks and dams at great expense.

Between Warwick and Montezuma, an estimated distance of 39 miles, the improvement consists mainly in the removal of logs and drift and overhanging trees, and has been sufficiently accomplished to permit navigation at moderate stages of water; but no commercial use has been made of this section of the river since July, 1890, when the Montezuma Steamboat Company disposed of their small steamer. It is not believed that any commercial benefit has since been derived from continuing the improvement of the Flint River above Albany. Two bridges, without draw openings, at distances, respectively, of 16 and 41 miles above Albany, obstruct steamboat navigation, but no measures have been taken to require the owners of the bridges to provide them with draw openings, for the reason that no complaints have been made against them.

It is useless to continue the improvement above Albany for commercial purposes unless these bridges are provided with draw openings, and it seems to be an unnecessary hardship to compel the owners to provide draw openings to accommodate a commerce which does not now exist and of which there is no immediate prospect. For this reason, and on account of the improbability of being able to secure a satisfactory navigation without the construction of locks and dams at a cost entirely incommensurate with any prospective commerce to be developed thereby it is recommended that no further allotments be made, for the present at least, for the improvement of the Flint River above Albany, but that the whole appropriation be expended in continuing the useful and important work below Albany.

July 1, 1893, balance unexpended	$9,606.83
June 30, 1894, amount expended during fiscal year	7,560.76
July 1, 1894, balance unexpended	2,046.07
July 1, 1894, outstanding liabilities	252.33
July 1, 1894, balance available	1,793.74
Amount appropriated by act of August 17, 1894	8,000.00
Amount available for fiscal year ending June 30, 1895	9,793.74
Amount that can be profitably expended in fiscal year ending June 30, 1896 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867, and of sundry civil act of March 3, 1893.	36,000.00

(See Appendix P 3.)

4. *Chattahoochee River, Georgia and Alabama.*—The river was originally much obstructed by logs, snags, and overhanging trees and by a number of rock and marl shoals and sand bars, so that navigation was difficult and dangerous. Steamboats could only run by daylight, and not unfrequently lay for weeks at a time awaiting a rise in the river. Very many were sunk by striking obstructions.

The present plan of improvement, adopted in 1873 and modified in 1882, contemplates a low-water channel 4 feet in depth and 100 feet in width from Columbus, Ga., to Chattahoochee, Fla., a distance of 224 miles, by the removal of snags and other obstructions from the channel and overhanging trees from the banks, by the excavation of rock shoals, and by works of contraction and shore protection.

Previous to the act of June 18, 1878, $70,000 was appropriated for the "Chattahoochee and Flint rivers," of which $52,000 was expended on the Chattahoochee River.

The expenditure of $256,861.81 up to June 30, 1893, had resulted in securing and maintaining a fairly good channel between Chattahoochee, Fla., and Eufaula, Ala., except at Rock Island, at all seasons of the year; and between Eufaula, Ala., and Columbus, Ga., except during low water, when considerable trouble was experienced at St. Francis Bend, Shell Creek, Upatoie, and Woolfolk bars, and at the shoals immediately below Columbus, on account of the lack of funds for keeping in repair and extending the contraction and shore-protection works at those points. The shore-protection and contraction works placed at Mound Bar during 1893 improved the channel, so that vessels no longer have trouble there.

Trouble is also experienced at low water at Francis Bend, Shell Creek, and Upatoie bars, above Eufaula, and at Rock Island, about 200 miles below Columbus.

If sufficiently large appropriations were made to improve these localities by substantial works, it is believed that thereafter the navigation of the river could be maintained in good condition throughout the year by annual appropriations of $10,000 for the operation of an efficient snag boat and for the maintenance of the contraction and shore-protection works.

The snag boat *Chattahoochee* is no longer fit for use. The wheel and the shear frame have been removed and put up on the bank so that the hull, having no longer to support these loads, may remain afloat. Urgent repairs are needed to other parts of the plant. The sum of $15,000 is necessary for urgent repairs.

For the above reasons an estimate of $100,000 is submitted for this improvement for the fiscal year ending June 30, 1896.

July 1, 1893, balance unexpended	$8,156.40
June 30, 1894, amount expended during fiscal year	7,049.60
July 1, 1894, balance unexpended	1,106.80
July 1, 1894, outstanding liabilities	141.67
July 1, 1894, balance available	965.13
Amount appropriated by act of August 17, 1894	25,000.00
Amount available for fiscal year ending June 30, 1895	25,965.13
Amount that can be profitably expended in fiscal year ending June 30, 1896 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	100,000.00

Between West Point and Franklin, Ga.—This section of 38 miles of the river consists of a series of pools, varying in length from one-half to 5 or 6 miles and separated by rock shoals and rapids, in some of which the fall is as great as 8 feet to the mile. In the pools the width of the river is from 300 to 500 feet, with a channel nowhere less than 4 feet deep. At the shoals the river is much wider, with numerous islands, and low-water depths in many places of only a few inches. The bottom is generally of rock and the banks are stable. There are few, if any, sand or gravel bars and but few snags.

The river and harbor act of September 19, 1890, provided for a preliminary examination of the Chattahoochee River between West Point and Franklin. This examination was made in November, 1890, and reports of results are printed at page 1756 of the report of the Chief of Engineers for 1891.

The river and harbor act of July 13, 1892, provided for "improving Chattahoochee River, Georgia and Alabama; continuing improvement, twenty-five thousand dollars, of which five thousand dollars are to be used on that portion of the river between West Point and Franklin."

The project for the improvement of this section of the river, submitted July 26, 1892, and approved August 4, 1892, contemplates removal of the lesser rock shoals, sand and gravel bars by excavation and by works of contraction, removal of overhanging trees from the banks and snags, logs, and other obstructions from the channel, and the construction of locks and dams to overcome the more serious obstructions to give a minimum depth of 3 feet at low water in the channel between West Point and Franklin, a distance of 38 miles.

During the fiscal year ending June 30, 1893, $2,759.61 was expended in procuring the necessary plant, in rock excavation at certain of the shoals above West Point, and in depositing the excavated material in training dams, and in making a survey for a short canal and lock around the 6-foot milldam at Bentley Mill.

During the fiscal year ending June 30, 1894, a channel 50 feet wide and 3 feet deep was secured through Flat Rock Shoals. A similar channel was begun at Roberts Shoals, but was left incomplete, the appropriation being exhausted. As a useful navigation for this section of the river can only be had by means of locks and dams at a cost which the traffic of the stream does not justify, no estimate is submitted for the fiscal year ending June 30, 1896.

July 1, 1893, balance unexpended	$2,240.39
June 30, 1894, amount expended during fiscal year	2,145.72
July 1, 1894, balance unexpended	94.67
Amount appropriated by act of August 17, 1894	5,000.00
Amount available for fiscal year ending June 30, 1895	5,094.67

(See Appendix P 4.)

5. *Choctawhatchee River, Florida and Alabama.*—When work on the improvement was begun, in 1874, the river, notwithstanding an average width of 300 feet, was almost totally obstructed by the accumulation of logs and snags, and navigation was only possible by flatboats of light draft. The channel, if a channel existed at all, was exceedingly dangerous to navigation, particularly during the lower stages of water.

The project for improvement adopted in 1880 provided for obtaining a low-water navigable channel from its mouth to Geneva, Ala., an estimated distance of 125 miles, and a navigable high-water channel from Geneva to Newton, Ala., an estimated distance of 37 miles.

In 1890 the project was amended to provide for securing a low-water channel from Geneva to Newton.

The improvement consists in the removal of logs, in deepening sand bars by works of contraction and shore protection, and in excavating a channel through the rock and marl shoals.

The expenditure, up to June 30, 1893, of $111,760.94 had resulted in removing the obstructions from the river between its mouth and Caryville sufficiently to meet the requirements of the present commerce on that section of the river, in giving a fairly navigable channel, except at extreme low water, from the crossing of the Pensacola and Atlantic Railroad at Caryville, Fla., to Geneva, Ala., a distance of 25 miles, and a partially improved channel from Geneva to Pate Landing, 25 miles above, and in providing a plant for carrying on, at the troublesome bars, works of contraction and shore protection, of which some were applied at Buzzard Bar, Gumfield Shoals, and Busby Shoals with such successful results that boats have experienced no trouble since then in passing them.

Steamboats now run with considerable regularity from Geneva, Ala., to the railroad at Caryville.

During the fiscal year ending June 30, 1894, $8,315.82 was expended in snagging, in the construction of a shore protection near Caryville, in cutting off the Old River, and in building contraction works and shore protection at Harveston Whirl. These works answer their object. They have made the passage of boats, even carrying large amounts of freight, safe by night and by day.

Geneva is a thriving town, the trading and shipping center for a rich agricultural region surrounding it. The river affords the only practicable means of transportation to this district. During recent years the work has, therefore, mainly been directed to improving this section of the river, and has resulted in clearing out a large number of the accumulated logs and snags. Low-water navigation is impeded by several sand bars, which can be readily deepened by works of contraction and shore protection if sufficient funds are appropriated for the purpose.

When freight offers steamboats occasionally run to Pate Landing at favorable stages of water.

Since the completion of the Alabama Midland Railroad from Montgomery, Ala., to Bainbridge, Ga., which passes through Newton, the urgent necessity for improving the upper portion of the river no longer exists, and it is doubtful if this section would now be much used even if the improvements were completed.

The plan, therefore, contemplates completing the improvement between Geneva and Caryville, and then between Geneva and Pate Landing before beginning any work upon the marl shoals which now obstruct navigation between Newton and Pate Landing. It is very doubtful whether a safe low-water navigation of this section of the river can be secured except by the construction of locks and dams, to provide slack-water navigation, at a cost not warranted by any prospective commerce to be developed thereby.

July 1, 1893, balance unexpended	$10,239.06
June 30, 1894, amount expended during fiscal year	8,175.12
July 1, 1894, balance unexpended	2,063.94
July 1, 1894, outstanding liabilities	140.70
July 1, 1894, balance available	1,923.24
Amount appropriated by act of August 17, 1894	6,000.00
Amount available for fiscal year ending June 30, 1895	7,923.24
Amount that can be profitably expended in fiscal year ending June 30, 1896 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	30,000.00

(See Appendix P 5.)

6. Harbor at Pensacola, Fla.—In 1878 the channel was much obstructed by wrecks, and a survey made in 1879 showed that the inner bar had shoaled to a least depth of 19.5 feet at mean low water. This depth was not sufficient to accommodate the large number of vessels seeking entrance to the port. The western shore of the entrance to the harbor, which is the site of old Fort McRee, was fast washing away, and a large portion of the fort had disappeared. Corresponding changes in the direction of the channel and of the tidal currents had occurred, and to this was attributed the shoaling of the inner bar. The removal of the wrecks was begun in 1878.

The plan of improvement adopted in 1881, in accordance with the report of The Board of Engineers, contemplated dredging a channel 300 feet wide and 24 feet deep at mean low water across the inner bar, for the temporary relief of the navigation of the harbor and protecting the shore line near Fort McRee from further abrasion, with the view of preventing injurious changes in the tidal currents, and retaining this position for defensive purposes.

A channel 120 feet wide and 24 feet deep at mean low water was the result of dredging done in 1886. This channel filled up so that in June, 1891, it was only 19 feet deep. It was then dredged out again to a least depth of 20.5 feet, but this depth was reduced to 19.2 feet in November, 1892.

Two groins, built near the site of Fort McRee, stopped further abrasion of the shore line. They were 360 and 220 feet long, respectively. They were finished in April, 1890.

Up to June 30, 1893, $266,706.15 had been expended on the improvement of this harbor. A contract was made with Mr. Rittenhouse Moore, on October 29, 1892, to dredge the channel at a cost of 63 cents per cubic yard. The contract required work to begin not later than January 1, 1893. This time was extended to May 11, 1893. The dredge arrived on May 13 and began work on May 24. Comparatively little was done up to the close of that fiscal year.

The beginning of the fiscal year ending June 30, 1894, found the dredging going on. It was continued until August 15, when it came to an end for lack of funds. The work done was a channel dug between the 24-foot curves inside and outside of the inner bar. The channel is 1,400 feet long and 225 feet wide. Up to June 30, 1894, the channel had again filled up, by an average amount of 3.7 feet. A part of the channel

150 feet wide has, at the close of the year, 21.5 feet of water; the remainder is only 19.5 feet deep.

On January 17, 1891, a Board of Engineers was appointed to assemble at Pensacola, Fla., for the purpose of considering and reporting upon the improvement of the harbor. The report of the Board, dated July 16, 1891, is printed in the Annual Report of the Chief of Engineers for 1891, page 1723, and extracts therefrom, describing the proposed method of securing a permanent deep channel at the entrance to Pensacola Harbor by means of two jetties, starting from the shores near forts Pickens and McRee, respectively, at an estimated cost of $1,830,000, are given in the report of the officer in charge.

July 1, 1893, balance unexpended	$83, 293. 85
June 30, 1894, amount expended during fiscal year	80, 770. 53
July 1, 1894, balance unexpended	2, 523. 32
July 1, 1894, outstanding liabilities	70. 48
July 1, 1894, balance available	2, 452. 84
Amount appropriated by act of August 17, 1894	100, 000. 00
Amount available for fiscal year ending June 30, 1895	102, 452. 84
Amount that can be profitably expended in fiscal year ending June 30, 1896 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	500, 000. 00

(See Appendix P 6.)

7. *Escambia and Conecuh rivers, Florida and Alabama.*—These rivers are really one river, that portion of the river from its headwaters in south Alabama to the Florida and Alabama State line being called the Conecuh River, and the portion in Florida, 61 miles long, being called the Escambia River. It empties into the Escambia Bay. Fully 60 per cent of the immense quantity of timber shipped from Pensacola Harbor is cut on lands tributary to the Escambia River and floated down in rafts to Pensacola Harbor.

The river originally was much obstructed by snags, sunken logs, and rock shoals, and by a very shoal bar at the mouth. Steamboat navigation was not attempted, and rafts had much difficulty in passing down the river.

The plan of improvement for this river, adopted pursuant to examinations and surveys made in 1878, contemplates the removal of snags, sunken logs, and other obstructions from the channel; cutting through the rock shoals, and deepening sand bars by works of contraction and shore protection, from the mouth of the river, in Pensacola Bay, to the mouth of Indian Creek, an estimated distance of 293 miles, for the purpose of facilitating the movement of saw logs and timber down the river, affording at the same time facilities for steamboat navigation.

The expenditures made on this river up to June 30, 1893, were $71,978.80. Their result was the providing, maintaining, repairing, and renewing of the necessary plant; dredging twice through the bar at the mouth of the river to let tugs pass drawing 5 feet; removing large quantities of logs and snags from the mouth to Jordan Shoals, a distance of 136 miles; keeping the improved channel free from logs and snags. At the end of 1893 the river was in such condition that rafts could run safely on stages of water above 2 feet for a distance of 106 miles from the mouth.

During the fiscal year ending June 30, 1894, the operations of previous years were continued, and the condition of the river was further improved.

This river and its tributaries pass through the extensive timber lands of south Alabama and Florida, and the value of the lumber annually taken to market by the river is estimated at over $1,800,000.

In order that the business may be carried on safely and profitably the river should be kept free from snags and like obstructions by an efficient snag boat; and a channel 100 feet wide and 8.5 feet deep should be dredged through the bar at the mouth of the river, in order that the large tugs employed in towing the rafts to Pensacola may cross the bar and enter the river for the purpose of reaching the rafts. The rafts are now floated across the bar and fastened to timber stands in the open bay, where they are exposed to sudden storms, and a large annual loss in money and lumber is thus occasioned.

The cost of dredging the bar at the mouth of the river is estimated at $12,000. The annual cost of operating the snag boat is estimated at $6,000, or $12,000 for two years.

July 1, 1893, balance unexpended	$2,688.91
June 30, 1894, amount expended during fiscal year	2,403.83
July 1, 1894, balance unexpended	285.08
July 1, 1894, outstanding liabilities	81.44
July 1, 1894, balance available	203.64
Amount appropriated by act of August 17, 1894	6,000.00
Amount available for fiscal year ending June 30, 1895	6,203.64
Amount that can be profitably expended in fiscal year ending June 30, 1896 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	24,000.00

(See Appendix P 7.)

8. *Alabama River, Alabama.*—Before improvements were begun, in 1878, the river was so full of sunken logs and snags that many steamboats were destroyed and navigation was both difficult and dangerous, on account of the many bars, shoals, and reefs, having low-water depths of only 2.5 to 3.5 feet. That portion of the river below the cut-off, 20 miles in length, was absolutely inaccessible during low water, and all landings situated thereupon had been deprived of steamboat service. At low-water stages boats could only run by daylight, and long detentions at the shoals and bars were frequent. The normal width of the upper river is from 500 to 600 feet, and of the lower river from 700 to 800 feet. In the portions of the river having these widths the low-water depths vary from 8 to 15 feet, but where the river has been widened by the erosion of its banks, bars, shoals, and reefs are found.

The original plan of improvement, adopted pursuant to an examination and partial survey of this river made under the act of Congress approved March 3, 1875, provided for obtaining a 4-foot low-water channel from the mouth of the river to Wetumpka, Ala. In 1892, the present plan of improvements was adopted, which provides for obtaining a low-water channel 6 feet deep from Wetumpka, Ala., to the junction with the Tombigbee River, 44 miles above Mobile, Ala., an estimated distance of 323 miles, by the removal of logs and snags from the channel and overhanging trees from the banks; by the removal of rock reefs and gravel bars by blasting and dredging; and deepening sand bars by works of contraction and shore protection, at an estimated cost (prior to the appropriation of July 13, 1892, of $70,000) of $386,251, exclusive of the cost of maintenance and snagging, estimated at $10,000 per annum.

The expenditure of $216,258.17 to June 30, 1893, had resulted in clearing the river of dangerous snags, logs, and overhanging trees; in maintaining an efficient stern wheel snag boat; in procuring an efficient plant for the construction of contraction and shore protection works; in improving many of the worst bars, and in protecting the shores at many points.

During the fiscal year ending June 30, 1894, the various operations of snagging, contracting the channel, and protecting the banks were continued with satisfactory results. The low-water depths on 8 bars is now 4.5 to 5.5 feet. The increased depths vary from 1.5 feet to 3.5 feet. The river is now navigable from Montgomery to Mobile at low water for boats not exceeding 4.5 feet draft.

When the appropriation of $70,000 by the act of July 13, 1892, became available, the only plant on this river consisted of the efficient stern-wheel snag boat *Wm. J. Twining*. A plant for two large working parties, one on the upper and one on the lower river, has now been procured, each plant consisting of one stern-wheel towboat, one quarter boat, one pile-driver barge, one small-decked flatboat for carrying piles, two stone barges, and one brush barge. The contraction works, built in 1878 and 1883, and in 1892, 1893, and 1894, have given so satisfactory results that no special difficulty is anticipated in securing low-water depths of 6 feet on the bars now having less depths, provided sufficiently large appropriations are made to carry on the work with an efficient plant and a large working force during the low-water season.

July 1, 1893, balance unexpended	$38,741.83
June 30, 1894, amounts received, refund, etc	149.39
	38,891.22
June 30, 1894, amount expended during fiscal year	34,798.46
July 1, 1894, balance unexpended	4,092.76
July 1, 1894, outstanding liabilities	856.60
July 1, 1894, balance available	3,236.16
Amount appropriated by act of August 17, 1894	50,000.00
Amount available for fiscal year ending June 30, 1895	53,236.16
Amount (estimated) required for completion of existing project (excluding cost of annual maintaince and snagging, $10,000 per year)	286,251.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	200,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix P 8.)

9. *Coosa River, Georgia and Alabama.*—With head waters in the mountains of northwestern Georgia the Coosawattee, Oostenaula, Coosa, Alabama, and Mobile rivers form, in fact, one great river, which, when the improvement of the Coosa river is completed, will furnish a continuous route of water transportation, 776 miles in length, through the mineral fields of north Alabama, the agricultural belt of middle Alabama, and the timber region of south Alabama to tide water at Mobile Bay.

A distance of 293 miles of this waterway, above Lock No. 4 (3 miles above the Georgia Pacific Railroad bridge) and a distance of 367 miles between Wetumpka and Mobile, are now navigable.

Between Lock No. 4 and Wetumpka, a distance of 116 miles, the Coosa River has a fall of 323 feet and is obstructed by a series of rock shoals and reefs, separated by stretches of good navigable water, varying in length from one-half to 8 miles. The low-water discharge of the

Coosa River at Wetumpka is 5,800 cubic feet per second; about the same as that reported for the Mississippi River at St. Paul.

The abundance of water, the stability of the banks and bottom of the river, and the rock foundations for locks and dams presented in nearly all cases, make the lower portion of the river peculiarly susceptible to permanent improvement by a system of slack-water navigation.

Pursuant to the various examinations and surveys made between 1870 and 1889 a plan of improvement has been adopted which contemplates the removal of the lesser rock shoals, sand, and gravel bars by excavation and by works of contraction, and the construction of locks and dams to overcome the more serious obstructions.

By the various acts making appropriations for its improvement the Coosa River has been divided into two sections by the East Tennessee, Virginia and Georgia Railroad bridge.

In the upper section, between Rome and the bridge (236 miles long), 8 locks, with their accessory dams, will be required, of which 3 have been completed and opened to navigation, and the fourth is now under construction.

In the lower section, between Wetumpka and the bridge (68 miles long), 23 locks, with their accessory dams, will be required, of which Lock No. 31, at Wetumpka, is now under construction. The first appropriation for this section of the river was made by the act of September 19, 1890.

(*a*) *Between Rome, Ga., and the East Tennessee, Virginia and Georgia Railroad bridge.*—Before improvement the river was much obstructed by rock shoals and sand and gravel bars between Rome, Ga., and Greensport, Ala., a distance of 162 miles; and below Greensport it was not navigable at all on account of the many shoals and rapids formed by ledges of rock crossing the river bottom at points where the width of the river was greater than the normal.

The expenditure up to June 30, 1893, of $753,407.44 had resulted in securing a fairly navigable channel from Rome to Greensport by blasting out the rock shoals and by the construction of wing dams to scour out the sand bars.

Below Greensport, at distances, respectively, of 0.68, 3.86, and 5.24 miles, 3 masonry locks, each having an available width of 40 feet and length of 175 feet, with their accessory dams, had been completed and opened to navigation. In consequence of the improvement steamboats made regular trips between Rome and Gadsden and, when business demanded it, extended their trips to a landing 1 mile below Lock No. 3.

At the site of Lock No. 4, 21 miles below Lock No. 3, the permanent dam and abutment had been nearly completed and the cofferdam partly built, making navigation practicable on a moderate rise to this point.

The result of the expenditure during the year ending June 30, 1894, is: The abutment of the dam has been finished, nearly all the stone for the masonry cut, the foundation for the lock wall partly excavated, and some of the masonry of the wall laid; several of the shoals and reefs have been improved.

In the improved portions during about nine months of the year there is 5 feet or more of water in the shoal places, and for the remaining three months there is ordinarily 3 feet. The river is never closed by ice.

If the new appropriation be sufficiently large it is expected that Lock No. 4 will be completed and opened to navigation during the year ending June 30, 1895.

July 1, 1893, balance unexpended	$50,292.56
June 30, 1894, amount expended during fiscal year	46,403.65
July 1, 1894, balance unexpended	3,888.91
July 1, 1894, outstanding liabilities	1,700.28
July 1, 1894, balance available	2,188.63
Amount appropriated by act of August 17, 1894	110,000.00
Amount available for fiscal year ending June 30, 1895	112,188.63
Amount (estimated) required for completion of existing project	850,133.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	600,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

b. Between Wetumpka, Ala., and East Tennessee, Virginia and Georgia Railroad bridge.—The first appropriation for the improvement of this section of the river was made by the act of September 19, 1890.

To June 30, 1893, the sum of $108,201.45 was expended in securing the necessary outfit and in making detailed surveys for the precise location of the locks near Wetumpka and in making a series of velocity and discharge observations, extending from high to low water; in filling up and grading the yard at the site of Lock No. 31 and building thereon workshops, etc.; in the purchase of machinery and plant for the construction of the cofferdam and Lock No. 31; in excavating rock from the channel of the river above Wetumpka bridge, and in building a breakwater to divert the current from the lock site; in constructing part of the cofferdam; in breaking stone and storing sand for concrete.

The amount expended during the year ending June 30, 1894, has been applied to constructing a narrow-gauge road from the lock to the work at the head of the rapids and to the yards of the Louisville and Nashville Railroad; in completing the cofferdam; in setting up pumping engines and concrete mixing plant; in building storehouse and sheds for materials, and in continuing excavation in the river above the lock. A contract has been made with the Atlas Cement Company, dated May 2, 1894, for furnishing 10,000 barrels of Portland cement.

July 1, 1893, balance unexpended		$141,798.55
June 30, 1894, amounts received, refund, etc		7.25
		141,805.80
June 30, 1894, amount expended during fiscal year		67,043.24
July 1, 1894, balance unexpended		74,762.56
July 1, 1894, outstanding liabilities	$4,889.82	
July 1, 1894, amount covered by uncompleted contracts	24,300.00	
		29,189.82
July 1, 1894, balance available		45,572.74
Amount appropriated by act of August 17, 1894		110,000.00
Amount available for fiscal year ending June 30, 1895		155,572.74
Amount (estimated) required for completion of existing project		4,733,074.00
Amount that can be profitably expended in fiscal year ending June 30, 1896		600,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.		

(See Appendix P 9.)

10. *Operating and care of canals and other works of navigation on Coosa River, Georgia and Alabama.*—The expenses of operating and care of locks Nos. 1, 2, and 3, and the canal between locks Nos. 2 and 3, dur-

ing the fiscal year ending June 30, 1894, amounting to $4,018.75, have been paid in the way indicated by section 4, act of July 5, 1884.

(See Appendix P 10.)

11. Cahaba River, Alabama.—The report of the examination of this river from its mouth to Centreville, Ala., in 1874, states that—

> On thirteen of the shoals there is only 1 foot of water, and on two as little as eight-tenths of a foot. Besides this there are innumerable snags, the accumulation of years, and also a great quantity of leaning trees, which must be removed owing to the narrowness of the stream even at a stage several feet above low water. * * * The river is spanned by three bridges. * * * The railroad bridges are only a few inches above high water, while the road bridge is sometimes submerged.

The road bridge mentioned was carried away by the flood of 1881.

Under the acts of Congress approved June 23, 1874, and June 17, 1880, examinations and partial surveys were made in 1874 and 1880, and a plan of improvement was adopted which provides for obtaining for the lower Cahaba River, from its mouth to the town of Centreville, a distance of 88 miles, a navigable channel with a width in open river of 100 feet, and in soft rock and bar cuts of 60 feet, and a depth at low water of 3 feet, by the removal of snags, etc., from the channel and overhanging trees from the banks, by cutting through the soft rock and gravel bars, and by contracting and regulating the channel.

The expenditure up to June 30, 1886, of $28,989.79 had resulted in the partial improvement of the river, from its mouth to the town of Centerville, for high-water navigation; but, on account of the obstructing railroad bridges, steamboats were unable to make any use of the improved river. Since that time no work has been done, because of the proviso in the river and harbor act of August 5, 1886, that—

> No part of said sum [$7,500 appropriated for this work] shall be expended until the officer in charge shall have reported that the railroad and other bridges across said river have been provided with good and sufficient draw openings.

These bridges continue to obstruct the navigation of the river, not having been provided with draw openings.

The act of September 19, 1890, provided that—

> The existing provision restricting the expenditure of the balance now available for continuing the improvement of said river is hereby repealed, and said balance shall be expended in continuing the improvement thereof.

Between June 30, 1886, and June 30, 1892, the sum of $8,430.44 was expended. In the spring of 1891 active operations on the river were resumed. A log boat suitable for snagging operations was built, and employed during the following summer in work below Wallace Ferry.

During the fiscal year ending June 30, 1893, $3,610.31 was expended in working on the lower 21¼ miles of the river. At the close of operations in December, 1892, the channel for this distance was free from overhanging timber, logs, and snags, but no commercial use was made of the improvement.

During the year ending June 30, 1894, the sum of $3,934.46 was expended with the result of clearing the river of snags and logs to a point 38¾ miles above the mouth.

On March 31, 1892, the officer in charge, in conformity with section 11 of the act of September 19, 1890, reported that the navigation of the Cahaba River was obstructed by the bridge of the Birmingham, Selma and New Orleans Railroad, about 10 miles above the mouth of the river, and by the bridge of the Alabama Central Division of the East Tennessee, Virginia and Georgia Railroad, about 22 miles above its mouth. Neither of these bridges has been provided with draw spans.

The officer in charge was directed to grant a hearing to each of the railroad companies, in accordance with the instructions of the War Department of September 16, 1891.

No commercial benefit commensurate with the cost of the work can be derived from continuing the improvement of the river unless the obstructing bridges are provided with draw spans to permit of steamboat navigation. There is no apparent desire on the part of those interested that the railroads shall be compelled to provide the bridges with draws. At the hearing mentioned above many affidavits by residents along the river were submitted, protesting against compelling the railroads to provide the bridges with draws, and not a word was received in favor of such action.

In view of these facts it is not considered that any money can be profitably expended in the improvement of the river during the fiscal year ending June 30, 1896, and no estimate is submitted therefor.

July 1, 1893, balance unexpended	$3,969.46
June 30, 1894, amount expended during fiscal year	3,914.85
July 1, 1894, balance unexpended	54.61
July 1, 1894, outstanding liabilities	19.61
July 1, 1894, balance available	35.00

(See Appendix P 11.)

IMPROVEMENT OF RIVERS AND HARBORS IN WESTERN ALABAMA AND EASTERN MISSISSIPPI, AND OF BOGUE CHITTO, LOUISIANA.

This district was in charge of Maj. A. N. Damrell, Corps of Engineers, with Lieut. Eben E. Winslow, Corps of Engineers, under his immediate orders; Division Engineer, Col. C. B. Comstock, Corps of Engineers.

1. *Mobile Harbor, Alabama.*—The channel had originally a minimum depth of 5½ feet through Choctaw Pass and 8 feet on Dog River Bar. This was deepened to 10 feet through both by dredging, under appropriations from 1826 to 1852 of $228,830.68. In 1860 the channel in Choctaw Pass had shoaled to 7½ feet. From 1870 to 1878 the channel was deepened by dredging to 13 feet, under appropriations amounting to $401,000. Length of cut 8 miles.

From 1881 to 1888 the channel was deepened by dredging to 17 feet, under appropriations amounting to $740,000, but this project was not completed when the last project was adopted. The length of cut was 25.91 miles.

The present project for the improvement of this harbor was adopted in August, 1888, the object being to afford a channel of entrance from the Gulf of Mexico to the City of Mobile of 280 feet width on top of cut, with a central depth of 23 feet at mean low water, by dredging at an estimated cost of $1,980,000. Act of September 19, 1890, extended the work up Mobile River to the mouth of Chickasabogue Creek, and increased the estimated cost to $2,043,800. The entire length of channel under present project is 33.09 miles, and the entire length of continuous cut is 32.27 miles. The amount expended on the present project up to the close of the fiscal year ending June 30, 1893, was $760,197.93 and resulted as follows:

The average central depth of the dredged channel on June 30, 1893, was 23.86 feet, and the minimum depth on that date was 19.6 feet. The amount expended during the fiscal year ending June 30, 1894, was $382,366.63, and on that date the average central depth of the entire channel was 25.2 feet, and the minimum central depth in the river was 19.6 feet and in the bay was 20.5 feet, with an average increase of bottom width of 75 feet.

July 1, 1893, balance unexpended		$552, 302. 07
June 30, 1894, amount expended during fiscal year		382, 366. 63
July 1, 1894, balance unexpended		169, 935. 44
July 1, 1894, outstanding liabilities	$104, 153. 89	
July 1, 1894, amount covered by uncompleted contracts	55, 000. 00	
		159, 153. 89
July 1, 1894, balance available		10, 781. 55
Amount appropriated by sundry civil act of August 18, 1894		390, 000. 00
Amount available for fiscal year ending June 30, 1895		400, 781. 55
Amount (estimated) required for completion of existing project		291, 300. 00
Amount (estimated) required for preservation of improvement		240, 000. 00
Amount that can be profitably expended in fiscal year ending June 30, 1896		291, 300. 00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.		

(See Appendix Q 1.)

2. *Black Warrior River, Alabama, from Tuscaloosa to Daniels Creek.*—The present channel is only navigable during very high water, and even then, very dangerous.

The present project for the improvement of the river was approved in 1887, the object being to afford a waterway for the transportation of coal, iron ore, iron, etc., in barges, from the Warrior Coal Fields to the Gulf of Mexico, by the construction of five locks and dams at an estimated cost of $741,670.

The amount expended to June 30, 1893, was $404,434.71, resulting as follows:

Lock No. 1: Masonry of lock and abutment completed; lock tender's house built; lock yard paved and banks sloped and paved, nearly; timber and stone filling for dam on hand; needle dam ready to put in.

Lock No. 2: Lock masonry completed; south bank sloped, paved, and turfed; rock filling for dam on hand, 378 yards; grading done for abutment, 3,091 yards; lumber for needle dam on hand and partly framed; face stone and coping for abutment in readiness.

Lock No. 3: Lock chamber excavated; masonry commenced; 2,579 yards of cut stone on hand; 1,750 yards of backing on hand; 932 yards of earth excavated for bank wall; 2,321 yards sand for mortar hauled.

The amount expended during the fiscal year ending June 30, 1894, was $76,537.22, and resulted as follows:

Completing laying of masonry in Lock 3 and abutments 2 and 3
Commencing Dam 3.
Putting needle dam in each lock.
Building two barges, 18 by 58.
Delivering, fitting up, and partly hanging gates for Lock No. 1.
Excavating channel below Lock 3.

The present condition of the work is as follows:

Locks 1, 2, and 3 are completed except gates and valves. These are now being placed in Lock 1. The three dam abutments are also finished, and the dams are in process of construction.

The gates and valves for locks 2 and 3 will be prepared during the autumn and winter and will be hung next summer, so that it is expected to have the three locks ready for navigation in the autumn of 1895.

The entire work will cost about $794,000, or about 8 per cent more than the original estimate. The entire increase may be ascribed to the 8-hour law for labor.

July 1, 1893, unexpended	$151,815.11
June 30, 1894, amount expended during fiscal year	76,537.22
July 1, 1894, balance unexpended	75,277.89
July 1, 1894, outstanding liabilities	6,133.66
July 1, 1894, balance available	69,144.23
Amount appropriated by act of August, 17, 1894	37,500.00
Amount available for fiscal year ending June 30, 1895	106,644.23
Amount (estimated) required for completion of existing project	200,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	200,500.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

(See Appendix Q 2.)

3. *Warrior and Tombigbee rivers, Alabama and Mississippi.*—(*a*) *Warrior River, Alabama.*—The channel of this river was originally obstructed to such an extent by logs, snags, overhanging trees, and numerous bars that navigation at low water was impossible, and at high water extremely hazardous.

The present project for the improvement of this river was adopted in 1890, the object being to obtain a channel 6 feet deep at ordinary low water from Tuscaloosa to its mouth, by removal of logs, snags, and overhanging trees, the improvement of bars, bank revetments, and the construction of locks and dams, at an estimated cost of $557,000.

The amount expended up to the close of the fiscal year ending June 30, 1893, was $64,966.68, in preparation of plant and the removal of logs, snags, and overhanging trees.

The amount expended during the fiscal year ending June 30, 1894, was $34,294.06 in the removal of snags, logs, slip-ins, and overhanging trees, and resulted in considerably reducing the time required to run the river and the hazard attending it.

July 1, 1893, balance unexpended	$69,001.30
June 30, 1894, amount expended during fiscal year	34,294.06
July 1, 1894, balance unexpended	$34,707.24
Amount appropriated by act of August 17, 1894	40,000.00
Amount available for fiscal year ending June 30, 1895	74,707.24
Amount (estimated) required for completion of existing project	417,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	250,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

(*b*) *Tombigbee River up to Demopolis, Ala.*—At the present time the channel has a minimum depth of 2 feet. The present project for the improvement of this section of the river was adopted in 1890, the object being to secure a channel of 6 feet depth at low water, by removal of logs, snags, trees and bank revetment, and construction of locks and dams, at an estimated cost of $508,808. The entire length of this section is 191 miles.

The amount expended prior to June 30, 1893, was $68,783.14, and resulted in the removal of logs, snags, trees, etc., from this entire section of the river, in the repair of jetties at Osage and Barneys

Shoals, the partial removal by blasting of rock shoals at Woods Bluff, and McGrews and Pearsons shoals.

The amount expended during the fiscal year ending June 30, 1894, was $24,730.94, and consisted in the removal of snags, logs, etc., that had accumulated since the previous year's work over 37 miles of the river; and dredging at Rainwater Bar and Barneys Shoal, repair of jetties and construction of shore protection.

Amount expended to June 30, 1894, $91,964.01, of which $1,550.07 was for preservation of improvement already obtained.

July 1, 1893, balance unexpended	$111, 216. 86
June 30, 1894, amount expended during fiscal year	24, 730. 94
July 1, 1894, balance unexpended	86, 485. 92
Amount appropriated by act of August 17, 1894	75, 000. 00
Amount available for fiscal year ending June 30, 1895	161, 485. 92
Amount (estimated) required for completion of existing project	253, 808. 00
Amount that can be profitably expended in fiscal year ending June 30, 1896	253, 808. 90
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(*c*) *Tombigbee River from Demopolis, Ala., to Columbus, Miss.*—The present channel has a minimum depth of 1 foot.

The present project for the improvement of this section of the river, 156 miles in length, was adopted in 1890, the object being to obtain a channel of 6 feet depth at ordinary low water by removal of logs, snags, etc., bank revetment, and construction of locks and dams, at an estimated cost of $779,400.

The amount expended up to June 30, 1893, was $25,575.28, and resulted in the preparation of a working plant and the removal of logs, snags, etc., for nearly the whole distance. The amount expended during the fiscal year ending June 30, 1894, was $8,618.19, and resulted in clearing the remaining distance, and the removal of obstructions that had accumulated since the work of the previous year over the greater portion of this section.

July 1. 1893, balance unexpended	$24, 424. 72
June 30, 1894, amount expended during fiscal year	8, 618. 19
July 1, 1894, balance unexpended	15, 806. 53
Amount appropriated by act of August 17, 1894	50, 000. 00
Amount available for fiscal year ending June 30, 1895	65, 806. 53
Amount (estimated) required for completion of existing project	679, 400. 00
Amount that can be profitably expended in fiscal year ending June 30, 1896	250, 000. 00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(*d*) *Tombigbee River from Fulton to Columbus.*—The channel before improvement was not navigable at all, except during high water, and navigation was practically suspended when the river reached 12 feet above low water.

The project for the improvement of this section of the river, from Fulton to Columbus, 144 miles, was adopted in 1873, the object being to give a good high-water channel throughout by the removal of snags, logs, and overhanging trees, at a cost of $35,000, and was completed in 1882, at a cost of $27,293.65.

The amount expended to June 30, 1893, was $41,326.72, and resulted in the completion of the improvement and partial preservation of same.

The amount expended during the fiscal year ending June 30, 1894 was $2,685.52, in preservation of the improvement.

July 1, 1893, balance unexpended	$2,806.53
June 30, 1894, amount expended during fiscal year	2,685.52
July 1, 1894, balance unexpended	121.01
Amount appropriated by act of August 17, 1894	4,000.00
Amount available for fiscal year ending June 30, 1895	4,121.01
Amount (estimated) required for preservation of improvement	20,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	20,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(*e*) *Tombigbee River from Walkers Bridge to Fulton, Miss.*—The channel was originally only navigable for small rafts during high water and very troublesome then.

The present project for the improvement of this section of the river was adopted in 1888, the object being to obtain a good channel for navigation during high water by the removal of logs, snags, stumps, and cutting overhanging trees, at an estimated cost of $11,000.

The amount expended to June 30, 1893, was $9,870.59 and resulted in completion of the project.

The amount expended during the fiscal year ending June 30, 1894, was $1,111.48, and resulted in the removal of the annual accumulation of snags, logs, and trees, in preservation of improvement.

The total amount expended on the improvement up to June 30, 1894, was $10,982.07, of which $3,390.96 was in preservation of improvement.

July 1, 1893, balance unexpended	$1,129.41
June 30, 1894, amount expended during fiscal year	1,111.48
July 1, 1894, balance unexpended	17.93
Amount appropriated by act of August 17, 1894	1,000.00
Amount available for fiscal year ending June 30, 1895	1,017.93
Amount (estimated) required for preservation of improvement	2,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	2,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix Q 3.)

4. *Noxubee River, Mississippi.*—The original condition of the river was such that during all seasons of the year and at all stages of water navigation, except by small flatboats, was practically impossible. The present project for the improvement of this river was adopted in 1880, the object being to afford a channel for small river steamers from its mouth up to Macon, Miss., of navigable width and depth when the water is above ordinary low-water stage.

The amount expended up to the close of the fiscal year ending June 30, 1893, was $52,966.41, and resulted in completion of the project.

The amount expended during the fiscal year ending June 30, 1894, was $1,096.22, and was used in removing the obstructions that have accumulated since the completion of the project.

July 1, 1893, balance unexpended	$3,033.59
June 30, 1894, amount expended during fiscal year	1,096.22
July 1, 1894, balance unexpended	1,937.37
Amount appropriated by act of August 17, 1894	3,000.00
Amount available for fiscal year ending June 30, 1895	4,937.37

Amount (estimated) required for preservation of improvement	$9,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	9,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix Q 4.)

5. *Pascagoula River, Mississippi.*—The channel over the bar before the improvement commenced had a least depth of 3 feet. This was increased to 7½ feet, with a width of 180 feet, by dredging from 1878 to 1880, at a cost of about $42,500. From the light-house near the mouth of the river to its head there was a navigable channel obtained by the removal of snags and overhanging trees from 1881 to 1884, inclusive, at a cost of about $15,000.

The present project for the improvement of this river was adopted in 1886, the object being to afford a channel of navigable width and minimum depth of 12 feet at mean low water from Moss Point down to the anchorage in the sound, and to maintain the river above Moss Point in its improved condition, at an estimated cost of $78,100 for the channel from Moss Point down, and $2,500 annually for preservation of improvement above Moss Point.

The amount expended to June 30, 1893, was $91,221.33, and resulted in the completion of more than three-fifths of the work needed to complete the project from Moss Point down to the anchorage in the sound.

The officer in charge reports that it has been necessary to increase the estimate for completion of this work, owing to the hardness of a portion of the material to be dredged and smallness of the appropriations.

The amount expended during the fiscal year ending June 30, 1894, was $745.07, and resulted in the improvement of 32 miles of river, from Carters Landing to Wilkinsons Ferry, in preservation of the improvement.

Total amount expended on the improvement up to June 30, 1894, was $91,966.40, of which $5,821.79 was in preservation of the improvement.

July 1, 1893, balance unexpended	$778.67
June 30, 1894, amount expended during fiscal year	745.07
July 1, 1894, balance unexpended	33.60
Amount appropriated by act of August 17, 1894	13,000.00
Amount available for fiscal year ending June 30, 1895	13,033.60
Amount (estimated) required for completion of existing project	36,000.00
Amount (estimated) required for preservation of improvement above Moss Point	22,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	58,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix Q 5.)

6. *Chickasahay River, Mississippi.*—At the time of the adoption of the present project the channel was only navigable for small rafts during high water, and was difficult and troublesome for them. The minimum width of the channel is 50 feet, and the minimum depth 0.5 foot at extreme low water. The project for the improvement of this river was adopted in 1890, the object being to obtain a good high-water channel from the mouth up to the railroad bridge near Shubuta by the removal of snags, logs, and overhanging trees, etc., at an estimated cost of $30,000.

The amount expended to June 30, 1893, was $6,446.46, and resulted in partial improvement of river from the mouth up to Waynesboro.

The amount expended during the fiscal year ending June 30, 1894, resulted in the complete improvement of the river from the mouth up to Crawfords Landing, a distance of 22¾ miles.

July 1, 1893, balance unexpended	$3,553 54
June 30, 1894, amount expended during fiscal year	3,513.25
July 1, 1894, balance unexpended	40.29
Amount appropriated by act of August 17, 1894	5,000.00
Amount available for fiscal year ending June 30, 1895	5,040.29
Amount (estimated) required for completion of existing project	15,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	15,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix Q 6.)

7. *Leaf River, Mississippi.*—At the time of the adoption of the present project the river was not navigable on account of snags, logs, and overhanging trees.

The minimum width of the river channel is 100 feet, and the minimum depth 2.5 feet.

The project for the improvement of this river was adopted in 1890, the object being to obtain a high-water channel from the mouth to the mouth of Bowie Creek, a distance of 75 miles, by the removal of snags, logs, and overhanging trees, at an estimated cost of $25,000.

The amount expended to June 30, 1893, was $5,125.78, and resulted in giving a partially improved channel from Hattiesburg to Augusta, Miss., a distance of 40 miles, and a fully improved channel from the mouth up, 15 miles.

The amount expended during the fiscal year ending June 30, 1894, was $4,083.61, and resulted in giving a fully improved channel for 45 miles.

Total amount expended on the improvement up to June 30, 1894, $9,209.39, of which $2,617.27 was in preservation of improvement.

July 1, 1893, balance unexpended	$4,874.22
June 30, 1894, amount expended during fiscal year	4,083.61
July 1, 1894, balance unexpended	790.61
Amount appropriated by act of August 17, 1894	2,500.00
Amount available for fiscal year ending June 30, 1895	3,290.61
Amount (estimated) required for completion of existing project	12,500.00
Amount required for preservation of improvement	1,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	14,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix Q 7.)

8. *Harbor at Biloxi, Miss.*—The original condition of the channel was such as to allow vessels of 4 feet draft to enter the harbor at low water.

The present project for the improvement of this harbor was adopted in 1882, the object being to afford a channel of entrance from Mississippi Sound to the wharves of Biloxi, of navigable width and 8 feet deep, at an estimated cost of $55,000.

The amount expended to June 30, 1893, was $36,411.84, and resulted in dredging a channel 9 feet deep at mean low water and 120 feet wide throughout and completion of the project.

During the fiscal year ending June 30, 1894, $7,912.31 was expended and resulted in giving a channel 160 feet wide and 9 feet deep.

About $8,000 every four or five years will be ample for preservation of the improvement.

July 1, 1893, balance unexpended	$8,624.16
June 30, 1894, amount expended during fiscal year	7,912.31
July 1, 1894, balance unexpended	711.85

(See Appendix Q 8.)

9. *Pearl River below Jackson, Miss.*—The original condition of this portion of the river was such as to allow navigation only during high water and then it was difficult and dangerous. The minimum width of the stream was 190 feet, except through Holmes Bayou, which was only 65 feet wide. The minimum width of the channel was 65 feet. The minimum depth of the channel at low water was 1½ feet.

The original project for the improvement was adopted in 1880, the object being to obtain a 5-foot channel at low water at an estimated cost of $95,940. This depth was found impracticable and the project was therefore modified in 1885 so as to reduce the depth to 2 feet and increase the estimate $50,000.

The amount expended on the work up to June 30, 1893, was $120,164.56.

The condition of this section of the river on June 30, 1893, was such as to allow light-draft boats to navigate from the mouth, at the Rigolets, Louisiana, to Wheats Fields, Miss., 106 miles, all the year; from Wheats Fields to Columbia, Miss., 50 miles, on a 6-foot rise, and from Columbia, Miss., to Jackson, Miss., 169 miles, on a 7-foot rise, and then it is dangerous.

The amount expended during the fiscal year ending June 30, 1894, was $4,362.88, and resulted in allowing light-draft boats to navigate from the mouth to Wheats Fields, 106 miles, all the year, completing that portion according to project.

From Wheats Fields to Jackson, 209 miles, the river has only been partially improved.

The amount expended on the improvement up to June 30, 1894, was $124,527.44, of which $21,457.11 was in preservation of improvement.

July 1, 1893, balance unexpended	$22,960.44
June 30, 1894, amount expended during fiscal year	4,362.88
July 1, 1894, balance unexpended	18,597.56
Amount appropriated by act of August 17, 1894	5,000.00
Amount available for fiscal year ending June 30, 1895	23,597.56
Amount (estimated) required for completion of existing project	15,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	15,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

(See Appendix Q 9.)

10. *Pearl River, between Carthage and Jackson, Miss.*—The original condition of this part of the river was such as to make navigation almost impossible except at high water.

The minimum width of the river was 100 feet; the minimum width of the channel was 40 feet.

The original project was to afford a clear channel of navigable width 5 feet deep at low water, from Jackson to Carthage, 105 miles, at an estimated cost of $21,000.

In 1886 the project was changed so as to reduce the depth to be obtained to 2 feet, and the estimate of cost was increased $29,000.

The amount expended on this work up to the close of the fiscal year ending June 30, 1893, was $26,252.49, and resulted in completion of the project.

The condition of the improvement on June 30, 1893, was such as to allow light-draft boats to navigate safely on a 3-foot stage above low water, from Jackson to Carthage.

The amount expended during the fiscal year ending June 30, 1894, was $3,489.43, in preservation of the improvement.

There is a large reduction and saving in freights and insurance rates.

July 1, 1893, balance unexpended	$4,997.51
June 30, 1894, amount expended during fiscal year	3,489.43
July 1, 1894, balance unexpended	1,508.08
Amount appropriated by act of August 17, 1894	2,400.00
Amount available for fiscal year ending June 30, 1895	3,908.08
Amount (estimated) required for preservation of improvement	4,800.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	4,800.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix Q 10.)

11. Pearl River, between Edinburg and Carthage, Miss.—The original condition of this portion of the river was such that navigation at low water was impossible, and even during high water it was difficult and dangerous.

The minimum width of the channel was 20 feet; the minimum depth at low water was 8 inches.

The project for the improvement, adopted in 1884, was to afford a high-water channel from Edinburg to Carthage, a distance of 24¾ miles for six or eight months of the year, at an estimated cost of $13,464.00.

The amount expended on this work up to June 30, 1893, was $14,727.59, and resulted in completion of the improvement.

The condition of this part of the river, June 30, 1893, was such as to allow light-draft boats to navigate with comparative safety from Edinburg to Carthage on a 4-foot rise above ordinary low water.

The amount expended during the fiscal year ending June 30, 1894, was $13.76.

Total amount expended on the improvement up to June 30, 1894, $14,741.35, of which $4,078.86 was in preservation of improvement.

July 1, 1893, balance unexpended	$522.41
June 30, 1894, amount expended during fiscal year	13.76
July 1, 1894, balance unexpended	508.65
Amount appropriated by act of August 17, 1894	500.00
Amount available for fiscal year ending June 30, 1895	1,008.65
Amount (estimated) required for preservation of improvement	1,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	1,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix Q 11.)

12. Bogue Chitto, Louisiana.—The channel at present is not navigable at ordinary low water, it being obstructed by snags, logs, fish traps, etc.

The minimum width of the stream is 120 feet and that of the channel 80 feet; the minimum depth is 3 feet.

The project for the improvement of this river was adopted in 1890, the object being to obtain a 3-foot channel during the greater part of the year by the removal of logs, snags, fish traps, etc., from the mouth up to Alford's bridge, at an estimated cost of $55,000.

The amount expended during the fiscal year ending June 30, 1893, was $2,072.40, and was applied to preparation of plant for the work.

The amount expended during the fiscal year ending June 30, 1894, was $4,551.80, and resulted in the improvement of 18 miles of river from the mouth up, according to the project.

July 1, 1893, balance unexpended	$6,927.60
June 30, 1894, amount expended during fiscal year	4,551.80
July 1, 1894, balance unexpended	2,375.80
Amount appropriated by act of August 17, 1894	5,000.00
Amount available for fiscal year ending June 30, 1895	7,375.80
Amount (estimated) required for completion of existing project	40,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	20,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix Q 12.)

13. *Removing sunken vessels or craft obstructing or endangering navigation.*—April 22, 1893, an allotment was made from the permanent indefinite appropriation provided for by section 4 of the river and harbor act of June 14, 1880, for the removal of the wreck of a sunken dry dock in Mobile River, Alabama.

The amount expended during the fiscal year ending June 30, 1894, was $615.57, for inspection of contract work.

Contract was made with W. H. Brown for this work for $2,500.

The contractor has abandoned the work without completing, having removed arches, machinery, top and greater portion of sides and ends, leaving ballast, entire bottom, part of sides and ends to be removed.

(See Appendix Q 13.)

INSPECTION OF THE IMPROVEMENT OF THE SOUTH PASS OF THE MISSISSIPPI RIVER.

The act of Congress of March 3, 1875, amended by acts of June 19, 1878, and March 3, 1879, made provision for the construction, by James B. Eads or his representatives, of jetties and other works in the South Pass of the Mississippi River, to secure and maintain a channel through the pass 26 feet deep, and through the jetties 26 feet deep and 200 feet wide at bottom, with a central depth of 30 feet; an annual payment of $100,000 was provided for the maintenance of such a channel for twenty years after first obtaining it by the works built. The required channels were secured in July, 1879.

The object of the examinations and surveys of the South Pass, the expenses of which are now provided for by the permanent indefinite appropriation made by act of August 11, 1888, is to determine if the channel is maintained as required by law, and to enable the inspecting officer to issue the certificates required for the quarterly payments. The officer in charge of these surveys is Maj. James B. Quinn, Corps of Engineers, whose annual report thereon and on work done during the year is submitted as Appendix R.

July 1, 1893, balance unexpended	$1,852.37
Amount allotted for fiscal year 1893-'94 under act of August 11, 1888	10,000.00
	11,852.37
June 30, 1894, amount expended during fiscal year	10,699.40
July 1, 1894, balance unexpended	1,152.97
July 1, 1894, outstanding liabilities	78.41
July 1, 1894, balance available	1,074.56
Amount allotted for fiscal year 1894-'95 under act of August 11, 1888	10,000.00
Amount available for fiscal year ending June 30, 1895	11,074.56

(See Appendix R.)

IMPROVEMENT OF RIVERS AND HARBORS IN SOUTHERN LOUISIANA AND EASTERN TEXAS.

This district was in the charge of Maj. James B. Quinn, Corps of Engineers; Division Engineer, Col. C. B. Comstock, Corps of Engineers.

1. *Chefuncte (Tchefuncte) River and Bogue Falia, Louisiana.*—Previous to improvement these streams were obstructed by snags, logs, and overhanging trees. The bar at the mouth of the river had a depth of water of about 4½ feet at the lowest stage.

The project for the improvement of the river was adopted in 1880, and contemplated the removal of obstructions in the channel and the dredging of the bar at its mouth, and was modified in 1884 so as to provide for the building of a breakwater across the bar.

With the first two appropriations of $1,500 each, made in 1881 and 1882, the obstructions were removed below Covington, and part of the unexpended balance was used for constructing 820 feet of the breakwater, but the bar at the mouth was not dredged, as it would be likely to re-form.

To prevent this or retard its re-formation the officer in charge in 1884 recommended building a breakwater extending 2,500 feet into the lake and then dredging a channel through the bar.

The original estimated cost of the improvement was $5,460, but this did not provide for building the breakwater.

Under the appropriation of $2,500 made in 1886, channels 5 feet in depth and 30 to 60 feet wide were cut through the bars on the Bogue Falia between Old Landing and Covington, giving better navigation for schooners to and from Covington.

Under the appropriation of $1,000 made in 1890, work was commenced in October, 1891, with the Government snagging plant and hired labor.

The river was cleared of logs, snags, impending trees, and other obstructions from Madisonville to Old Landing, and from the latter place to Covington, on the Bogue Falia, as far as the available funds would permit. Work was discontinued November 30, 1891, and the plant laid up at Madisonville.

The total amount expended on these streams to June 30, 1893, was $6,758.74. The river was then navigable for steamers drawing 5 feet to Old Landing, about 12 miles above its mouth, and then for the lighter-draft schooners to Covington, about 2 miles farther up on the Bogue Falia. The bar at the mouth of the river has a depth of about 5 feet at low water.

No work was done during the year just closed, beyond care of the plant.

The amount expended during the year just closed was $206.65.

July 1, 1893, balance unexpended	$741.26
June 30, 1894, amount expended during fiscal year	206.65
July 1, 1894, balance unexpended	534.61
Amount appropriated by act of August 17, 1894	1,000.00
Amount available for fiscal year ending June 30, 1895	1,534.61
Amount that can be profitably expended in fiscal year ending June 30, 1896	1,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

(See Appendix S 1.)

2. *Tickfaw River and its tributaries, Louisiana.*—When the project for improvement was adopted the Tickfaw River and its navigable branches were obstructed by snags, sunken logs, and trees.

Congress authorized an examination of this river in 1879. A project was submitted in 1881 to clean out the river and its principal tributaries, the Natalbany, Blood, and Pontchatoula rivers, by removing the obstructions, at an estimated cost of $10,230.

To June 30, 1891, the appropriations made by Congress in 1881, 1882, 1886, and 1888, aggregating $7,000, had been expended. Twenty miles of the Tickfaw, and the Natalbany to Springfield, the head of navigation, had been improved. Work was also done on the Pontchatoula as far as it was thought advisable, and the Blood River had been cleaned out as far as navigable.

Under the appropriation of $1,000 made September 19, 1890, work of removing the obstructions that had re-formed since 1889 was commenced September 14, 1891, with hired labor and the use of the Government snagging plant, which had but recently finished work on the Amite River. Operations were discontinued in October of that year.

Snags, overhanging trees, and logs were removed from the Tickfaw, Natalbany, and Blood rivers, the latter being cleared to the head of navigation. The extent of channels improved on the three rivers was about 39 miles.

To the close of the year ending June 30, 1893, there had been expended on these streams the sum of $8,796.30.

The work done has resulted in a very material increase in the commerce of the river. Most of the shipments are made direct to New Orleans.

Under the appropriation of July 13, 1892, work was commenced at the mouth of the river on December 20, 1892. The result of operations during that fiscal year was the improvement of about 30 miles of channel by removing obstructions.

No work has been done during the past year beyond care of the plant. The amount expended during the year just closed was $30.

Obstructions will continue to form in all these streams, and the improvement, therefore, is not permanent. It is estimated that $1,000 will be required annually to keep the channels in good condition.

July 1, 1893, balance unexpended	$203.70
June 30, 1894, amount expended during fiscal year	30.00
July 1, 1894, balance unexpended	173.70
Amount appropriated by act of August 17, 1894	1,000.00
Amount available for fiscal year ending June 30, 1895	1,173.70
Amount that can be profitably expended in fiscal year ending June 39, 1896	1,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

(See Appendix S 2.)

3. *Amite River and Bayou Manchac, Louisiana.*—Before improvement was commenced the Amite River and Bayou Manchac, its principal tributary, were navigable by the ordinary river steamboat below and for a short distance above their point of junction, but the navigation was very much impeded and endangered by snags, stumps, impending trees, etc.

In 1880 a project was adopted for the improvement of the Amite River, providing for a low-water channel 5 feet in depth as far up stream as appropriations would permit, the main part of the work to be done above the mouth of the Bayou Manchac. An effort was made to do the work by contract, but the results were unsatisfactory, and in 1883 the original project was modified so as to permit the use of the Government plant and hired labor, the improvement to be made below the mouth of the Bayou Manchac.

Under the appropriation of September 19, 1890, the work of improvement was continued from July 1 to August 29, 1891, with the Government snagging plant. Obstructions were removed from the bayou between its mouth and Hope Villa, and from the river between its mouth and the junction with Bayou Manchac. The extent of channel improved during this time was about 13 miles.

July 13, 1892, an appropriation of $2,500 was made for maintenance, $1,000 of which was to be used to construct a turning basin for boats at or near the mouth of Wards Creek, on Bayou Manchac.

As this sum, $1,000, was not deemed sufficient for dredging out a turning basin, it has been held for further increase.

After thoroughly repairing the snagging plant used on this improvement, work was commenced November 17, 1892, with the remainder of the appropriation, at Wards Creek, on Bayou Manchac, and was carried on to Port Vincent, on the Amite River, removing the most dangerous obstructions, and resulting in improving about 20 miles of channel, giving much relief to the navigation of the river and bayou. Operations were discontinued on December 15 following.

To June 30, 1893, the sum of $25,044 had been expended on the improvement of these streams. At that date vessels drawing 5 feet of water could navigate the bayou from its mouth to Wards Creek, on the Bayou Manchac, and the river was navigable for vessels of like draft from the mouth to its junction with the Bayou Manchac. Navigation is, however, somewhat hampered by obstructions which have formed since operations ceased in December, 1892.

No work has been done during the past year.

The amount expended during the year ending June 30, 1894, was $45.

Owing to the caving of the banks of these streams, the permanent improvement is hardly possible, and about $2,500 will be required annually to keep them free of obstructions.

An appropriation of $2,000 is required, in addition to the $1,000 now available, for dredging a turning basin for boats at or near the mouth of Wards Creek, on the Bayou Manchac.

July 1, 1893, balance unexpended	$1,256.00
June 30, 1894, amount expended during fiscal year	45.00
July 1, 1894, balance unexpended	1,211.00
Amount appropriated by act of August 17, 1894	2,500.00
Amount available for fiscal year ending June 30, 1895	3,711.00
Amount that can be profitably expended in fiscal year ending June 30, 1896 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	4,500.00

(See Appendix S 3.)

4. *Bayou Lafourche, Louisiana.*—Prior to 1879 the navigation of the Bayou Lafourche was very much obstructed by snags, logs, raft heaps, impending trees, and wrecks.

In 1879 a project was approved for the removal of these obstructions, and work under this project was carried on until 1885.

In 1888 Congress appropriated $50,000 for the improvement of the bayou on the plan of Lieutenant Crosby, Corps of Engineers, dated June 11, 1886, and provided for dredging for the immediate relief of low-water navigation.

Lieutenant Crosby's project was for a lock at the head of the bayou, connecting it with the Mississippi River, and subsequent dredging of the bayou channel to a width of 75 feet, with a depth of 5 feet at mean low water of the gulf. The estimated cost was $450,000, with an annual expenditure of $8,000 for operation and maintenance.

The act of September 19, 1890, appropriated $50,000 for this stream, and also provided for immediate dredging to secure low-water navigation. July 13, 1892, an appropriation of $50,000 was made for continuing improvement and removing obstructions.

Under the provision of the act of August 11, 1888, dredging was commenced at the head of the bayou, and has been continued since at intervals. There had been expended on the improvement of this stream to June 30, 1893, the sum of $105,334.53, with considerable benefit to the low-water navigation. At that time flatboat navigation was rendered practicable during low water throughout the bayou.

Upon the subsidence of the high water in 1893 dredging operations were resumed on September 6, and continued until high water again caused a suspension of the work on March 1, 1894. During this time dredging was done on that portion of the bayou between Donaldsonville and a point 2 miles above Lockport, and numerous snags, logs, stumps, and wrecks were removed from the channel, enabling planters to float their crops and merchandise during the entire period.

The amount expended on this work during the fiscal year ending June 30, 1894, was $14,645.10.

Dredging here is a very unsatisfactory method of improvement, as much of the work has to be gone over again after the subsidence of the flood in the Mississippi River. If the lock were constructed whatever dredging was thereafter done would be practically permanent, and the certainty and safety of the navigation of the bayou assured.

July 1, 1893, balance unexpended	$74, 665. 47
June 30, 1894, amount expended during fiscal year	14, 645. 10
July 1, 1894, balance unexpended	60, 020. 37
Amount appropriated by act of August 17, 1894	40, 000. 00
Amount available for fiscal year ending June 30, 1895	100, 020. 37
Amount (estimated) required for completion of existing project	310, 000. 00
Amount that can be profitably expended in fiscal year ending June 30, 1896	100, 000. 00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

(See Appendix S 4.)

5. *Bayou Terrebonne, Louisiana.*—When work was commenced in 1880, Bayou Terrebonne was little better than a drainage ditch, being about 11 feet wide when dredging began.

The project called for the dredging of a channel 4 feet deep at mean low water of the gulf to Houma. The cost of the improvement of this bayou was estimated at $38,800. The completion of the work to Houma as projected cost $35,808, enabling planters to ship their merchandise to Houma, or else to New Orleans, by connecting bayous and canals.

The dredge belonging to this appropriation having suffered extensively from decay, was put in good repair, exhausting the money available for this improvement.

The channel dredged by the United States has stood very well, but will probably require some attention in the near future to keep it in good condition.

The amount expended during the year ending June 30, 1894, was $1,755.26.

July 1, 1893, balance unexpended	$2,992.00
June 30, 1894, amount expended during fiscal year	1,755.26
July 1, 1894, balance unexpended	1,236.74
July 1, 1894, outstanding liabilities	1,079.34
July 1, 1894, balance available	$157.40

(See Appendix S 5.)

6. Bayou Plaquemine, Grand River, and Pigeon Bayous, Louisiana.—The work of securing the mouth of Plaquemine Bayou from further caving is under the charge of Capt. John Millis, Corps of Engineers, whose annual report thereon is submitted as Appendix T. A summary of the work done under his direction is given below, page 232.

Previous to the closing of the mouth of Bayou Plaquemine by a dam, in 1867 or 1868, the largest steamboat passed through it into Grand Lake and the numerous water routes connected with it.

In 1885 a project was proposed for reestablishing this water route by building a lock at the head of the bayou and dredging out the channel below. In 1888 $100,000 was appropriated for improving the bayou and protecting the bank at its mouth from caving; $75,000 of this sum was allotted to bank protection at the mouth; the remainder has been devoted to dredging out the bayou, so as to give a channel 60 feet wide and 6 feet deep at mean low-water level of the gulf.

This dredging progressed until, at the end of June, 1891, it had nearly reached the railroad bridge. The cut was about 5 miles long and 30 feet wide, and $16,948.31 had been expended on this work at that time.

During the following fiscal year the dredging was continued until the bridge was reached, and since the draw in this bridge had not been completed the dredge turned back and widened the cut to 60 feet for a distance of about one-half mile from the bridge. The amount expended on this work during the year ending June 30, 1892, was $5,846.41.

The proposed channel is incomplete and, until the lock at the head of the bayou is built, of but little service to navigation and liable to deteriorate.

In 1890 $100,000 was appropriated for continuing the improvement. Of this sum $60,000 was allotted for bank protection at the mouth. A project for the expenditure of the remainder by commencing work upon the lock was presented, but as the lock proposed by a Board of Engineer Officers was estimated to cost $700,000, the sum available was held for increase by further appropriation by Congress.

The total expended on this improvement to June 30, 1893, from funds allotted to this office was $32,652.55.

In 1892 $150,000 was appropriated for continuing improvement, of which $10,000 was for improving Grand River and Pigeon Bayous, forming a part of the Bayou Plaquemine route. An allotment of $72,000 was made from this appropriation for bank protection at Plaquemine.

During the past year dredging was carried on in the bayou from January 11 to June 30, 1894, and resulted in excavating 87,940 cubic yards of material, consisting mainly of hard bule clay, and removing a number of logs and stumps from the channel.

Work was also continued from August 17 to October 2, 1893, on the Grand River and Pigeon Bayou routes, improving about 30 miles of channel by removing 1,484 sunken logs and overhanging trees and 4½ miles of raft. The completion of this work opens a competing steamboat route in connection with the Texas and Pacific Railway at Plaquemine, and has caused a reduction of about 33⅓ per cent in freight rates from the Teche.

Title to all the land needed for the lock at Plaquemine has been obtained. The buildings located on this property were sold at public auction and the proceeds of sale turned into the Treasury.

The money available for commencing work on the lock is not considered sufficient to carry it to a point of safety, and the unexpended balance is held for further increase.

The money statement following is for the entire work on Bayou Plaquemine, the amounts for securing the mouth of the bayou from further caving (page 232) being included:

July 1, 1893, balance unexpended	$210,432.91
June 30, 1894, amount expended during fiscal year	150,517.89
July 1, 1894, balance unexpended	59,915.02
July 1, 1894, outstanding liabilities	2,174.85
July 1, 1894, balance available	57,740.17
Amount appropriated by act of August 17, 1894	110,000.00
Amount available for fiscal year ending June 30, 1895	167,740.17
Amount (estimated) required for completion of existing project	1,248,250.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	500,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix S 6.)

7. *Bayou Courtableau, Louisiana.*—At the time of the adoption of the present project the backwater from the Atchafalaya River formed a large sand deposit, known as Little Devil Bar, at the mouth of the Courtableau.

The approved project of 1880 contemplated the closing of some run-out bayous in order to confine the water in the Courtableau and cause its current to wash out the bar at its mouth; after this was accomplished, then to construct a timber lock and dam to give slack-water navigation to Washington, La. In 1883 the estimate was increased to $78,500, and provided for a masonry lock.

Up to June 30, 1893, the sum of $31,036.48 had been expended in closing run-out bayous, with the effect of partially removing the bar.

In 1890 $2,200 was appropriated. With this money work was commenced September 8, 1891, and continued until November 20 of that year, using the Government plant and hired labor. During this time the dams at bayous Cane, Mamzelle, and Big Fordoche were all repaired with piles and sheet piles, brush aprons being placed above and below them, and all were left in good condition. The sum of $260.85 was expended on this improvement during the year ending June 30, 1893. Nothing has been done during the past year beyond the care and preservation of the plant.

Little Devil Bar has washed out considerably under the influence of the dams, so as to give a navigable depth at a stage of water in the Atchafalaya River 7 feet below the level at which navigation was interrupted in the summer of 1891, but it is considered doubtful if, with all the run-out bayous closed, a channel navigable at low water can be maintained over this bar which, under any circumstances, will certainly form at each high water of the Atchafalaya.

The dams are in fair condition, but the older ones will require extensive repairs in another year.

The success of the dams so far built appears to warrant their maintenance and the permanent closure of the remaining run-out bayous.

There seems to be sufficient water in the bayou to wash out the bar at its mouth, formed by the backwater of the Atchafalaya, if it can be held within the banks which the closure of the run-out bayous by dams appears to affect.

July 1, 1893, balance unexpended	*$163.52
July 1, 1894, balance unexpended	163.52
Amount appropriated by act of August 17, 1894	5,000.00
Amount available for fiscal year ending June 30, 1895	5,163.52
Amount that can be profitably expended in fiscal year ending June 30, 1896 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893	5,000.00

(See Appendix S 7.)

8. *Bayou Teche, Louisiana.*—Previous to improvement the bayou had a navigable depth of about 8 feet, but the channel was obstructed by snags, logs, impending trees, and wrecks.

The project adopted contemplated the removal of these obstructions, and money having been appropriated the stream was thoroughly cleared from Port Barre down.

In 1886 this work was completed, but further obstructions had formed in the bayou since then, and in 1890 an appropriation of $5,000 was made with which to accomplish their removal, the work to be confined to that portion of the stream between the mouth and St. Martinsville.

Work under this appropriation was commenced by hired plant on October 12, 1891, and continued until December 10 of that year, resulting in the improvement of about 59 miles of channel from St. Martinsville down, and giving much relief and satisfaction to the commerce of the bayou.

No work was done during the past year.

The amount expended on the improvement of this stream to June 30, 1893, was $51,387.49.

Sunken logs, fallen trees, and coal-boat wrecks are continually forming obstructions in the bayou, consequently the improvement can not be considered as permanent.

The stream is also obstructed at present by shoals, caused by material being washed into the channel by drainage ditches. The navigable depth over these bars at times during the low-water season is not more than 3 feet.

The amount expended during the year ending June 30, 1894, was $47.52.

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* $6.07 of this amount refunded by Southern Pacific Railroad Company on account of overpayment on freight charges between New Orleans and Morgan City, La.

July 1, 1893, balance unexpended	$612.51
June 30, 1894, amount expended during fiscal year	47.52
July 1, 1894, balance unexpended	564.99
Amount appropriated by act of August 17, 1894	6,000.00
Amount available for fiscal year ending June 30, 1895	6,564.99
Amount that can be profitably expended in fiscal year ending June 30, 1896	30,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix S 8.)

9. Channel, bay, and passes of Bayou Vermillion, Louisiana.—Bayou Vermillion was at one time navigated throughout its length, but since the construction of the Southern Pacific Railroad the navigation has been confined to that portion below the railroad bridge.

A preliminary examination of the bayou, bay, and passes was made in January, 1891. At that time the upper 12 miles of the bayou had not a navigable depth of much over 2 feet, and below that the depth was not less than 5½ feet through the bayou, bay, and passes. The width of the bayou was from 100 to 400 feet.

The approved project of 1892 contemplated the removal of obstructions, such as snags, sunken logs, and impending trees in the bayou, and the marking of the channel through the bars in the bay with guide piles. The estimated cost of the improvement, to provide for 5½ feet depth of water up to the railroad bridge, was $25,000.

July 13, 1892, Congress made an appropriation of $7,500 for this work. Work under contract was commenced December 1, 1892, at a point about 18 miles above the mouth, improving 37½ miles of channel and securing a depth of 5½ feet over that portion of channel improved by removing snags, logs, overhanging trees, and other obstructions.

The snagging part of the contract was completed March 9, 1893, and by reason of the force and violence of the elements an extension of time was granted the contractor for driving the guide piles in Vermillion Bay.

There had been expended on this work to June 30, 1893, the sum of $5,923.20.

The work done during the fiscal year ending June 30, 1894, was the driving of 50 guide piles for marking the channel in Vermillion Bay, this completing the contract under the first appropriation for this improvement. The money expended during the year just closed amounted to $1,130.99.

July 1, 1893, balance unexpended	$1,576.80
June 30, 1894, amount expended during fiscal year	1,130.99
July 1, 1894, balance unexpended	445.81
Amount appropriated by act of August 17, 1894	5,000.00
Amount available for fiscal year ending June 30, 1895	5,445.81
Amount (estimated) required for completion of existing project	12,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix S 9.)

10. Mermentau River and tributaries, Louisiana.—A survey of this river, including its tributaries and course through Lake Arthur and Grand Lake to the Gulf of Mexico, was made in 1891. At that time the least depth at Viterboville and for a distance of 5 miles below that point was 7 feet; thence to Lake Arthur the depth was not less than 30 feet. Through Lake Arthur the channel had a minimum depth of 7 feet. From Lake Arthur to Grand Lake the least depth was 24 feet. Through Grand Lake the uniform depth was 6 feet. Immediately below Grand Lake the river was 30 feet deep, but the depth from that point to the mouth gradually decreased. At the mouth inside the depth was 13 feet. About 5 miles above the mouth, at the head of a lake, occurred a shoal, through which a channel was found of 7 feet, available for steamers, but too crooked for sailing vessels, as there was but 5 feet over the flats. All the soundings were referred to mean low tide in the gulf.

The stream had a width of 70 feet at Viterboville, and maintained the same width for a distance of 7 or 8 miles, where it began to gradually widen, until at the mouth of the Nezpique it attained a width of 250 feet. From that point to Lake Arthur the Mermentau River was generally 350 feet wide.

In 1892 a project was approved which contemplated the removal o obstructions, such as logs, snags, and overhanging trees in the upperf river and a mud flat in the lower, the removal of this flat to be accomplished by brush wing dams. The cost of improving this stream from Viterboville, on the Bayou Nezpique, to the mouth of the Mermentau River, was placed at $23,615.25.

July 13, 1892, an appropriation of $7,500 was made for this improvement.

Work under this appropriation was commenced December 8, 1892, with hired plant under contract at the lower end of Lake Arthur and was carried on up the Mermentau River, improving about 38 miles of channel by removing snags, overhanging trees, etc., materially lessening the dangers of navigation on that portion of the stream which is most used. Work ceased on March 7, 1893.

The amount expended on this work to the close of the year ending June 30, 1893, was $7,054.03.

There has been expended during the year just closed $22.08.

July 1, 1893, balance unexpended	$445.97
June 30, 1894, amount expended during fiscal year	22.08
July 1, 1894, balance unexpended	423.89
Amount appropriated by act of August 17, 1894	5,000.00
Amount available for fiscal year ending June 30, 1895	5,423.89
Amount (estimated) required for completion of existing project	11,115.25
Amount that can be profitably expended in fiscal year ending June 30, 1896	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix S 10.)

11. Mouth and Passes of Calcasieu River, Louisiana.—Previous to improvement there was not to exceed 3 feet depth over the bars in Calcasieu Lake.

In 1888 $10,000 was appropriated for this work, but as the permanency of the channels required that they be protected by a revetment of some kind, this sum was deemed as entirely too small, and was held for further increase.

In 1890 $75,000 was appropriated for the improvement of the mouth of the Calcasieu River, but as the kind of construction indicated in the act could not be safely undertaken with so small a sum, it was also held for further increase.

The approved project contemplates the dredging of suitable channels 12 feet deep through the head and foot of Calcasieu Lake and revetting these channels to prevent the return of the dredged material, and to build parallel piers of brush and stone at the entrance to the outer pass, extending from the shore on either side to the deep water of the gulf, and to dredge between these piers, if necessary. The estimated cost of the improvement was placed at $600,000.

In 1892 $100,000 was appropriated for the improvement of the river and pass, and contracts were accordingly let for the construction of a jetty upon the east side of the channel across the bar in the gulf and for the construction of a revetment to protect a channel to be dredged through the bar at the head of the pass.

Bids were invited for the dredging, but none were received which were deemed reasonable, and accordingly this work was authorized to be done with the dredge belonging to the Government.

The total amount expended on the improvement to June 30, 1893, was $56,462.95. At that time the revetment was nearly completed, and 1,104 feet of the east jetty had been built.

During the year ending June 30, 1894, the 10,000 linear feet of the revetment in Calcasieu Lake was completed, but was afterwards damaged considerably by storm in November last, and $3,102.80 was expended in its repair. By a subsequent storm much damage was done to the structure, which will necessitate further repairs as soon as funds are available.

Dredging was commenced in July, 1893, and continued until February following, when the dredge was hauled out and thoroughly repaired. Dredging will be resumed early in the ensuing year.

Work on the east jetty was carried on throughout the year and resulted in its extension by 5,753 feet. Its total length is now 6,857 feet.

The effect of the jetty is distinctly marked, although it has not reached a point sufficiently far out to give certain indications as to whether it will answer without a jetty to the westward, to secure the required depth by natural scour. The impression is that dredging will have to be resorted to, as with the present length of jetty the depth of channel across the bar is little greater than normal, although it has changed its location under the influence of the jetty.

The amount expended on this improvement during the fiscal year ending June 30, 1894, was $118,081.51.

The improvement when completed will be of considerable benefit to commerce, and, besides the deepening of the water across the bar in the gulf, will permit vessels to enter the pass for refuge during stormy weather.

July 1, 1893, balance unexpended		$175,037.05
June 30, 1894, amount expended during fiscal year		118,081.51
July 1, 1894, balance unexpended		56,955.54
July 1, 1894, outstanding liabilities	$26,558.05	
July 1, 1894, amount covered by uncompleted contracts	21,929.56	
		48,487.61
July 1, 1894, balance available		8,467.93
Amount appropriated by act of August 17, 1894		90,000.00
Amount available for fiscal year ending June 30, 1895		98,467.93
Amount (estimated) required for completion of existing project		335,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896		335,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

(See Appendix S 11.)

12. *Harbor at Sabine Pass, Texas.*—Originally there was scarcely 6 feet depth of water on the bar at the entrance to Sabine Pass, and, as the bar was composed of very soft mud, all efforts to maintain a channel through it of 12 or 16 feet depth by dredging were unavailing.

In 1882 a project for the improvement of this entrance was approved. It provided for the construction of jetties on either side of a channel connecting the deep water of the pass with that of the gulf.

The estimated cost of this improvement was $3,177,606.50.

Since the approval of this project there has been appropriated $1,448,750. A total of $1,528,593.79 had been expended to June 30, 1893, of which sum $1,208,593.79 was expended under the present project.

The east jetty then had a length of 17,100 feet, 16,615 feet of which had been raised to 2 feet above mean high water and 35 feet up to mean low water. The outer 450 feet consisted of foundation work only.

The west jetty at that date had a length of 12,840 feet, 6,609 feet of which had been raised to 2 feet above mean high water, and the remainder only built to the level of mean low water, and was incomplete.

At that time there was an unobstructed channel into the pass of 11 feet, but owing to the soft material composing the bar vessels drawing 13 feet could pass through the channel in safety.

During the year just closed work on the west jetty and dredging channel between jetties have been carried on under contracts.

The channel is now full 16 feet deep at mean low tide from deep water in the pass to the 17-foot contour of depth in the gulf, and is 100 feet wide. Vessels drawing 17.5 feet have cleared the pass.

The west jetty is now 14,875 feet long, 6,609 feet of which is raised to 2 feet above mean high water and 7,966 feet is being brought up to mean low water. The outer 300 feet is foundation work only.

The east jetty has a length of 17,100 feet. The outer 450 feet is foundation work only. The crest of rock section is 9.8 feet above mean low water. There has been an apparent settling of 0.2 foot in this section during the year. The jetty remained in good condition, with the exception of about 9,000 feet; 6,000 feet of which had settled 1½ feet, and 3,000 feet had settled 2 feet, leaving this portion from 0 to 6 inches above mean high water. A great deal of this subsidence is due to the displacement of the rock by wave action, particularly near the outer end.

In the beginning the jetties were built of alternate layers of brush and stone, but the rapid disappearance of the brush led to the adoption of the present method, which is, first to lay a brush mat and then build a riprap structure on this reaching 2 feet above mean high water.

The amount expended on this improvement during the fiscal year ending June 30, 1894, was $187,498.17.

July 1, 1893, balance unexpended	$240, 156. 21
June 30, 1894, amount expended during fiscal year	187, 498. 17
July 1, 1894, balance unexpended	52, 658. 04
July 1, 1894, outstanding liabilities	44, 310. 89
July 1, 1894, balance available	8, 347. 15
Amount appropriated by act of August 17, 1894	275, 000. 00
Amount available for fiscal year ending June 30, 1895	283, 347. 15

Amount (estimated) required for completion of existing project	$1,453,856.50
Amount that can be profitably expended in fiscal year ending June 30, 1896	1,000,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

(See Appendix S 12.)

13. Sabine River, Texas.—When the improvement of the river was commenced there was a depth of 3½ feet on the bar at its mouth, and also above the town of Orange. Logs, snags, etc., above here interfered with navigation. To June 30, 1889, there had been appropriated for this work $34,700, of which $30,760.39 had been expended.

In 1880 a channel 6 feet deep and from 70 to 100 feet wide was dredged through the bar. In 1881 several small cuts, to avoid bends obstructed with logs, were made above Orange.

An examination above Orange showed many snags in parts of the channel, and a project was prepared and contract entered into for the expenditure of the remaining balance in closing both branches of Old River, at the head of the Narrows, with pile, brush, and earth dams, to throw all the water in the useful channel, and removing the obstructions, such as snags, overhanging trees, etc.

The smaller Old River Channel was closed and most of the piles driven for the larger dam, when a sudden rise in the river washed out many piles in the latter. The river remaining so high that satisfactory work could not be done, the contract was extended to the next low-water season.

Work was resumed in September, 1890, and the dams finished, as projected, in December following, completing the project.

The dredged channel over the bar at the mouth is somewhat obstructed by snags, logs, etc., but the depth is now sufficient for the present demands of commerce.

The amount expended on the improvement of this river to June 30, 1893, was $34,795.04.

Under provisions of the river and harbor act of September 19, 1890, an examination of this river from Sabine Lake to Sudduths Bluff was made and a project submitted providing for the removal of obstructions from the river between these points, at an estimated cost of $10,000.

July 13, 1892, Congress appropriated $5,000 for improving Sabine River up to Sudduths Bluff, Texas.

The snagging plant contracted for commenced operations at a point 18 miles above Orange on July 1, 1893, and completed the work September 26, 1893, improving 17½ miles of channel by the removal of 1,325 obstructions.

During the fiscal year ending June 30, 1894, the sum of $4,736.93 was expended on this improvement.

After the obstructions in the river between its mouth and Sudduths Bluff are removed about $2,000 will be required annually to keep the stream in navigable condition.

July 1, 1893, balance unexpended	$4,904.96
June 30, 1894, amount expended during fiscal year	4,736.93
July 1, 1894, balance unexpended	168.03
Amount appropriated by act of August 17, 1894	5,000.00
Amount available for fiscal year ending June 30, 1895	5,168.03

(See Appendix S 13.)

14. Neches River, Texas.—Before this river was improved the bar at its mouth had only 3 feet of water over it, and navigation was obstructed between Yellow Bluff and Bevilport by snags and fallen trees.

The project adopted for the improvement of this river called for the dredging of a channel over the bar at its mouth and the removal of obstructions from the river between Yellow Bluff and Bevilport.

In 1880 a channel was dredged through the bar at the mouth of the river 5 feet deep and 30 to 60 feet in width. In 1882 the river between Yellow Bluff and Bevilport was cleared of obstructions.

The bar at the mouth had again shoaled, so that at extreme low water there was only a navigable depth of about 3 feet. The channel was again dredged to a depth of 5 feet by the Government dredge, which had been at work at Calcasieu Pass, and the work was completed in April, 1889, since which time no work has been done.

The improvement will not be permanent, as the bar will re-form.

The sum of $33,000 has been appropriated for this work, of which $28,842.16 had been expended to June 30, 1893.

July 1, 1893, balance unexpended	$4,157.84
July 1, 1894, balance unexpended	4,157.84

(See Appendix S 14.)

15. Removing sunken vessels or craft obstructing or endangering navigation.—Authority having been obtained, the following wrecks were removed, under contracts, from navigable channels during the year:

The dredge boat *W. H. Moon*, in Lake Pontchartrain, Louisiana. Contract completed January 23, 1894.

The steamboat *G. W. Anderson*, in Grand River, Louisiana. The contract was completed on January 15, 1894.

The wreck or obstruction in Ship Island Harbor, Mississippi Sound. The work was completed on January 25, 1894.

The obstructions were blown up with dynamite and all parts removed from the channels, where they will not again interfere with navigation. Nothing of value was recovered from the wrecks.

The removal of the wrecked steamboat *E. H. Barmore*, in Big Pigeon Bayou, Louisiana, was accomplished without cost to the Government.

The total cost to the Government of the removal of these wrecks was $2,312.99.

(See Appendix S 15.)

SECURING MOUTH OF BAYOU PLAQUEMINE, LOUISIANA, FROM FURTHER CAVING.

This work was in the charge of Capt. John Millis, Corps of Engineers; Division Engineer, Col. C. B. Comstock, Corps of Engineers.

Bayou Plaquemine was formerly an outflowing branch of the Mississippi River, but the levee system on the west bank of the river was carried across the bayou many years ago. It is now proposed to improve and deepen the bayou and establish navigable connection between it and the Mississippi by a system of locks at the town of Plaquemine.

The west bank of the river at this point is subject to rapid caving, threatening the site of the proposed locks.

The project adopted for the improvement contemplates a system of submerged spur dikes placed at intervals of about 900 feet, with intervals protected by continuous revetment. The dikes and revetment are built of timber and brush, ballasted with rock.

Up to the close of the fiscal year ending June 30, 1893, there had been expended $106,661.54, and five of the dikes had been built.

During the past year continuous revetment had been laid, covering in part the intervals between dikes, so there is now 1,400 linear feet of protection work below the site of the proposed lock and 1,200 feet above, with an unprotected interval of 500 feet left to enable necessary excavation for the lock entrance to be made.

During the year $72,000 additional was allotted for this work, an. there was a balance of $27,085.46 on hand from the last allotment The amount expended was $99,059.75, leaving a balance of $25.71.

The money statement is consolidated with that for the general improvement of Bayou Plaquemine, Louisiana, page 225.

(See Appendix T.)

IMPROVEMENT OF CERTAIN RIVERS AND HARBORS IN TEXAS.

This district was in the charge of Maj. A. M. Miller, Corps of Engineers, having under his immediate orders Lieut. William C. Langfitt, Corps of Engineers, to August 23, 1893, and Lieut. Lansing H. Beach, Corps of Engineers, since August 21, 1893; Division Engineer, Col. C. B. Comstock, Corps of Engineers.

1. *Entrance to Galveston Harbor, Texas.*—The obstructions to deep-water navigation at this harbor have been the outer and inner bars. On the former the natural depth was 12 feet, and on the latter about 13 feet, both at mean low tide.

The present project for improvement at this locality was adopted in 1874, modified in 1880, and again modified in 1886, the object being to deepen the channel so as to admit seagoing vessels of the deepest draft. The projects prior to 1874 related to dredging operations on a small scale.

The projects for 1874 and 1880 contemplated construction of jetties to deepen the channels on the bars, the former with a view to a depth of 18 feet. The modification of 1886 was with a view to a possible depth of 30 feet by means of jetties, to be supplemented, if need be, by dredging, these jetties to be of rock and to be built to a height of 5 feet above mean low tide. The cost of the modification of 1886 (the present project) was estimated at $7,000,000.

The total amount expended under the foregoing plans to June 30, 1893, was $3,359,639.82, in addition to which there was expended $100,000 subscribed by the city of Galveston in 1883. There was then a depth at mean low tide of 14 feet on the outer bar and 23 feet where the inner bar was, an increase of 2 feet and 10 feet, respectively, since the work began.

The expenditure during the fiscal year ending June 30, 1894, of $1,008,824.68 has resulted in obtaining 14.5 feet on the outer bar and 24¼ feet where the inner bar was, an increase in depth of ½ foot and 1¼ feet, respectively, since last year.

The work during the year consisted in extending the north jetty gulfward 12,600 feet, of which 8,500 feet was completed. The total work done, since operations began in 1887, is represented by 32,829 feet of south jetty, of which 32,000 feet is completed and 829 feet uncompleted, and 16,200 feet of north jetty, of which 10,000 feet is completed and 6,200 feet is uncompleted.

July 1, 1893, balance unexpended		$1,468,478.18
June 30, 1894, amount expended during fiscal year		1,008,824.68
July 1, 1894, balance unexpended		459,653.50
July 1, 1894, outstanding liabilities	$222,164.00	
July 1, 1894, amount covered by uncompleted contracts	222,662.94	444,826.94
July 1, 1894, balance available		14,826.56
Amount appropriated by sundry civil act of August 18, 1894		600,000.00
Amount available for fiscal year ending June 30, 1895		614,826.56
Amount (estimated) required for completion of existing project		3,050,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896		1,000,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

(See Appendix U 1.)

2. *Ship channel in Galveston Bay, Texas.*—This is a channel dredged through Galveston Bay by the United States Government from Bolivar Channel to Morgan Cut, the latter terminating at a point 4.8 miles from Morgan Canal, an excavation across Morgan Point at the mouth of the San Jacinto River. Morgan Cut and Canal were formerly the property of the Buffalo Bayou Ship Channel Company, but were purchased by the United States and the transfer was made May 4, 1892.

The natural depth on the line of the Galveston Bay Ship Channel averaged 8½ feet at mean low tide, with a depth in some places of but 7 feet; the ruling depth in Morgan Cut was 7½ feet, and in the canal 17 feet.

The project for this improvement was adopted in 1871, modified in 1877, and again modified in 1892. This latter modification became necessary owing to the acquisition by the United States of the Morgan Cut and Canal. The object of the improvement is to excavate and maintain a channel, 100 feet wide at the bottom and 12 feet deep, from Bolivar Channel to the San Jacinto River, a distance of 24.33 miles, thereby giving an outlet to the commerce of Buffalo Bayou, of San Jacinto River, of Trinity River, and of Cedar Bayou.

A channel, having a least width of 100 feet and depth of 12 feet, was excavated from Bolivar Channel to Morgan Cut in 1 88 and 1889, but as no dredging was done from then to June 30, 1893, the channel had shoaled again to an average depth of 8 feet. The amount expended on this improvement up to that time was $557,315.80.

The sum of $40,332.78 was expended on this improvement during the fiscal year ending June 30, 1894, and was applied to deepening and widening the channel from the Morgan Canal to the Morgan Beacon, a distance of 4.8 miles. The amount of material dredged was 153,376 cubic yards, the depth in the channel being increased from 8 to 9.5 feet a gain of 1.5 feet for navigation. There is now an average depth of 9.5 feet from Bolivar Channel to the Morgan Canal.

This project is not capable of permanent completion, as the shifting sands in the bay cause the channel to shoal considerably when work is suspended. It is estimated that the sum of $100,000 will be required annually to maintain the channel after it has been excavated to the required width and depth.

July 1, 1893, balance unexpended		$69,184.20
June 30, 1894, amount expended during fiscal year		40,332.78
July 1, 1894, balance unexpended		28,851.42
July 1, 1894, outstanding liabilities	$8,031.66	
July 1, 1894, amount covered by uncompleted contracts	18,772.82	
		26,804.48
July 1, 1894, balance available		2,046.94
Amount appropriated by act of August 17, 1894		50,000.00
Amount available for fiscal year ending June 30, 1895		52,046.94
Amount (estimated) required for completion of existing project		219,675.44
Amount that can be profitably expended in fiscal year ending June 30, 1896		200,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.		

(See Appendix U 2.)

3. *Channel in West Galveston Bay, Texas.*—The channels through West Galveston Bay were originally dredged in 1859 by the State of Texas to a depth of 5 feet, but during the storm of 1875 they shoaled to a depth of from 2½ to 3 feet at mean low tide, and at the same time became too narrow to allow vessels to pass through them except at full tide. Subsequent storms probably caused further filling of the channels.

The project for this improvement was adopted in 1892, and consisted in widening, deepening, and straightening the channel by dredging, so as to afford a least width of 200 feet and depth of 3½ feet between the railroad bridges and San Luis Pass in the bay, and a least width of 100 feet and depth of 3 feet along Christmas Point, the channel to be marked by suitable beacons. The total estimated cost was $28,998.80.

The amount expended on this improvement to June 30, 1893, was $2,317.71, and was applied to dredging a channel at Deer Islands reef. The small amount of material removed was not, however, enough to benefit commerce, as no portion of the channel had been completed.

The sum of $3,749.82 was expended during the present fiscal year in continuing work at the same locality. The channel across the reef was nearly completed, only a small portion south of the islands remaining to be dredged. As soon as this has been done, one obstacle to vessels navigating the bay will have been removed, as a channel from 100 to 160 feet wide and having the required depth of 3.5 feet at mean low tide will be available for navigation across Deer Islands reef.

July 1, 1893, balance unexpended		$12,682.29
June 30, 1894, amount expended during fiscal year		3,749.82
July 1, 1894, balance unexpended		8,932.47
July 1, 1894, outstanding liabilities	$489.47	
July 1, 1894, amount covered by uncompleted contracts	8,443.00	
		8,932.47
Amount appropriated by act of August 17, 1894		5,000.00
Amount (estimated) required for completion of existing project		9,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896		9,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.		

(See Appendix U 3.)

4. *Trinity River, Texas.*—This stream discharges into Galveston Bay, through several mouths or passes. Opposite each of these a bar exists, over which there is a depth of but 3.5 feet at mean low tide,

which is not sufficient for purposes of navigation, at least 5 feet of water being required.

The project, adopted for the improvement of this stream in 1873 and amended in 1889, contemplates the erection of two parallel jetties at the mouth of the middle pass, the one principally used by vessels, extending 7,750 feet into Galveston Bay and placed about 275 feet apart, and in closing the other passes by submerged dams, the object being to obtain 6 feet of water on the bar at mean low tide.

The amount expended to June 30, 1893, was $56,746.93. Of this amount part was applied to constructing jetties, of which 6,159 feet of west and 300 feet of east jetty is still in good condition, and the balance was used in dredging a channel across the bar. Owing to suspension of operations and natural causes this channel had shoaled so that there was no appreciable change in the depth over the bar at that time.

During the fiscal year ending June 30, 1894, $8,437.83 was expended in constructing an extension of 1,200 feet to the west jetty, making it in all 7,359 feet long, and in dredging a channel across the bar, having a width of 100 feet and depth of 5 feet at mean low tide, so as to afford immediate benefit to navigation. This channel is ample for navigation purposes, but to preserve it it will be necessary to extend the east jetty out to the 5-foot contour in the bay.

July 1, 1893, balance unexpended	$10,253.07
June 30, 1894, amount expended during fiscal year	8,437.83
July 1, 1894, balance unexpended	1,815.24
Amount appropriated by act of August 17, 1894	5,000.00
Amount available for fiscal year ending June 30, 1895	6,815.24
Amount (estimated) required for completion of existing project	17,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	17,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix U 4.)

5. *Cedar Bayou, Texas.*—The navigation on this stream was obstructed by a bar which had formed at the mouth of the bayou where it emptied into Galveston Bay. The depth of water in the bayou above the bar was 7 feet, and in the bay beyond the bar 5 feet, whereas the natural depth on the bar between the two was but 3 feet.

The project adopted for this improvement consisted in the construction of two stone and brush jetties, about 250 feet apart where they crossed the bar, and extending from the mainland to the 5-foot contour in Galveston Bay. These jetties were to protect a channel having a depth of 5 feet and a width of about 100 feet, which was to be dredged, connecting the 5-foot curve in the bayou with the 5 foot curve in the bay.

The amount expended to June 30, 1893, was $24,478.45, which was applied to dredging a cut on the bar and protecting it by jetties, resulting in a channel 1,840 feet long by 64 feet wide, and having a ruling depth of 5 feet.

The amount expended during the fiscal year ending June 30, 1894, was $7,671.55 and was applied to extending and widening the channel between the jetties, the amount of material removed being 21,000 cubic yards. The completed channel is now 2,830 feet long, 90 feet wide, and 5 feet deep at mean low tide, which practically completes the project, as far as the dimensions of the channel are concerned. It will, however, require the sum of $6,500 to extend the jetties to a length sufficient to preserve this channel.

July 1, 1893, balance unexpended	$7,671.55
June 30, 1894, amount expended during fiscal year	7,671.55

Amount (estimated) required for completion of existing project	6,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	6,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix U 5.)

6. *Buffalo Bayou, Texas.*—The channel of this stream between the city of Houston and Simms Bayou, a distance of 11 miles, was, in its natural condition, narrow and tortuous, and the natural depth in many places was not more than 5 feet. Below Simms Bayou it is wide and deep.

The project for its improvement was adopted in 1881, the object being to straighten the channel, widen it to 100 feet, and deepen it to 12 feet; also to remove such snags, stumps, and overhanging trees as were obstructions to navigation.

The amount expended to June 30, 1893, was $173,217.98. It has resulted in clearing the channel of the most prominent stumps, snags, and overhanging trees, in easing most of the bends, and in removing such shoals as obstructed an 8-foot navigation.

The amount expended during the past fiscal year was $19,921.51, and has resulted in a further easement of bends and deepening of the bayou, so that a 10-foot channel is now available in the bayou from Houston to Harrisburg, a distance of 8 miles. Obstructions were also removed from the bed and banks of the stream. These obstructions are renewed in more or less degree every year through action of floods. The project is not capable of permanent completion.

July 1, 1893, balance unexpended	$20,532.02
June 30, 1894, amount expended during fiscal year	19,921.51
July 1, 1894, balance unexpended	610.51
Amount appropriated by act of August 17, 1894	15,000.00
Amount available for fiscal year ending June 30, 1895	15,610.51

Amount (estimated) required for completion of existing project	176,549.75
Amount that can be profitably expended in fiscal year ending June 30, 1896	50,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See appendix U 6.)

7. *Harbor at Brazos Santiago, Texas.*—In its natural state the channel over this bar was shifting and its depth varied from 6 to 8 feet. The present (original) project for its improvement was adopted in 1881, the object being to fix the position of the channel over the bar at the entrance and to deepen it. The total amount expended to June 30, 1893, was $189,858.59, besides an appropriation of $6,000 in 1878 applied to removing a wreck. This expenditure has had no useful effect upon the bar, and the works heretofore constructed have practically disappeared.

The amount expended during the fiscal year was $75.41, and was principally applied to keeping a record of commercial statistics.

July 1, 1893, balance unexpended	$57,626.41
June 30, 1894, amount expended during fiscal year	75.41
July 1, 1894, balance unexpended	57,551.00

Amount (estimated) required for completion of existing project....$1,071,030.23
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix U 7.)

WESTERN RIVERS.

IMPROVEMENT OF CERTAIN RIVERS AND WATERWAYS IN LOUISIANA, TEXAS, ARKANSAS, MISSISSIPPI, AND TENNESSEE, TRIBUTARY TO MISSISSIPPI RIVER; WATER GAUGES ON MISSISSIPPI RIVER AND PRINCIPAL TRIBUTARIES.

This district was in the charge of Capt. J. H. Willard, Corps of Engineers; Division Engineer, Col. C. B. Comstock, Corps of Engineers.

1. *Red River, Louisiana and Arkansas.*—The improvement of this river was begun in 1828, and appropriations aggregating $535,765.50 were made between 1828 and 1852. Between 1841 and 1852 no appropriation was made, and a longer interval elapsed between 1852 and 1872, during which the results of former work were lost.

The present improvement commenced in 1872, at which time the river above Shreveport, La., was closed by the great raft 32 miles long and increasing continually; the falls at Alexandria were impassable at low stages; navigation was affected seriously by the gradual enlargement of Tones Bayou Outlet, 19 miles below Shreveport, which depleted the main channel; and navigation was obstructed by snags, raft, sunken logs, wrecks, and leaning timber throughout the entire length of the river.

The project of 1872 contemplated removing the great raft and closing Tones Bayou. Subsequently it was enlarged to include the removal of jams, snags, wrecks, leaning trees, etc.; opening and enlarging the channel through the falls of Alexandria, La.; deepening shoal places, and closing outlets and constructing and repairing levees to confine the river to the adopted channel; to improve and keep navigation open from Fulton, Ark., to the head of Atchafalaya River, Louisiana, a distance of 507 miles; also to protect the banks at Alexandria and Shreveport from erosion, and to make a thorough and comprehensive survey on which to base plans and estimates for permanent improvement.

The amount expended from 1872 to June 30, 1893, was $1,079,604.28 (including outstanding liabilities of $1,676.32), resulting in great benefit to navigation. A channel was cleared through the great raft in 1873, opening to navigation 188 miles of river between Shreveport and Fulton, and, at high stages, about 138 miles above Fulton. The subsequent work of snag boats, aided by the action of the current and by the incomplete levee system, secured greater width and depth throughout the raft region, with a channel constantly scouring, until now there flows in a course marked out for it a broad and deep river, safe at all but the lowest stages. Since 1872 the low-water line has fallen more than 15 feet at head of the raft, diminishing to about 3 feet at Shreveport, and a similar reduction has been going on in the river below. Moderate estimates, made in 1872, placed the annual saving to the planting interest by the removal of the raft at $150,000, besides relieving to a great extent not less than 25,000 acres of fertile lands from overflow. No work for the closure of Tones Bayou has been done since 1882, when the dam under construction was destroyed. That outlet, however, is filling up gradually with drift, which, in connection with the work done in the old raft region above and below its mouth, has caused the main channel to widen and scour, until not less than two-thirds of the flood water is carried by Red River, where twenty-one years ago three-quarters escaped through Tones Bayou or over the banks into Bayou Pierre, and as the stretch has been leveed along both sides there is no doubt that Red River soon will carry the whole. The rock excavation and dam at the falls of Alexandria were completed in 1885, increasing the period of navigation about two months, and as a general thing permitting boats to pass the falls the year round. The passage, however, was found difficult at low stages, and in 1892–'93 dredging was resumed, improving navigation at the upper falls greatly, and leaving only a small amount of work to make it safe. A crib dam and training wall were built in 1884–'85 to protect the bank in front of Alexandria from erosion, and in 1892–'93 this work was strengthened and the caving bank below the influence of the dam revetted with the stone excavated at the upper falls. The removal of obstructions from the channel and clearing the banks for the general improvement of the river were not begun until 1878, but since 1885 operations have consisted chiefly of that class of work, and by persistent efforts of snag boats the river has been kept open, raft prevented from forming, the dangers of navigation reduced to a minimum, and steamboats enabled to make regular trips at the lowest stages of water. The work of closing outlets and building levees to confine the river to the adopted channel was begun in 1891, when the Sale and Murphy Outlet, near the Arkansas and Louisiana line, was closed by a heavy earthen dam, which caused the channel through the old raft region below to scour rapidly. In the fiscal year 1893 a system of levees was begun by cooperation with the State of Louisiana and local levee boards, and during that year work was undertaken to the amount of 3,246,088 cubic yards, aggregating 75 miles in length, at a cost of more than $550,000, of which only about one-tenth was built by the United States, and the proportion of its cost was less than 9 per cent. The survey of the river was carried from Fulton to the Atchafalaya, and checked by a line of precise level from Delta to Shreveport, La., and continuing down Red River from Shreveport to the mouth.

During the fiscal year ending June 30, 1894, the removal of obstructions by means of snag boats was continued with benefit to navigation at all stages, and especially during the periods of low water. The river between the head of the old raft and the mouth of Black River was worked over thoroughly twice, special attention having been given to the most obstructed portions. Valuable work was accomplished in the raft region above Shreveport, permitting the local packet to follow the track of the snag boat, making quick time and encountering no obstructions at the lowest stage of water of record. What is known as the Little River, below Tones Bayou to Knox Point, was worked over at frequent intervals, to remove obstructions in the channel, shore snags, and timber on caving and sliding banks. Dredging at the upper falls, near Alexandria, was continued until the allotment for the work was exhausted; 3,483 cubic yards of rock was excavated from the channel, the greater portion of which was used for raising and strengthening the crib dike and revetting the caving bank. For confining the river to the adopted channel, about 79,000 cubic yards of levee work was built by the United States, in conjunction with a much larger quantity done by local districts and the State of Louisiana. The channel through the lakes and Cypress Bayou, between Shreveport, La., and Jefferson, Tex., was cleared of stumps, leaning timber, etc., under the allotment for that work. Field work of the survey was limited to a reconnoissance from Fulton to the Atchafalaya to determine changes, make borings, etc. Gauge observations at high and low stages were made, and the construction of maps was continued.

The amounts expended during the year were:

For general improvement	$17,763.58
For work at Alexandria	1,875.35
For Little River from Scopini Cut-off to Knox Point	2,155.52
For construction of levees	14,539.49
For survey of Red River	15,732.89
For Cypress Bayou and the lakes	1,682.83
Total	53,749.66

July 1, 1893, balance unexpended	$97,072.04
Received on account of overpayments to land-grant railroads	37.31
	97,109.35
June 30, 1894, amount expended during fiscal year	53,749.66
July 1, 1894, balance unexpended	43,359.69
July 1, 1894, outstanding liabilities	64.75
July 1, 1894, balance available	43,294.94
Amount appropriated by act of August 17, 1894	150,000.00
Amount available for fiscal year ending June 30, 1895	193,294.94
Amount that can be profitably expended in fiscal year ending June 30, 1896	1,000,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix V 1.)

2. *Red River above Fulton, Ark.*—The project adopted for this work in 1886 contemplated removing snags, drift, etc., above Fulton, Ark., to the mouth of Kiamichi River, Indian Territory, about 138 miles, to give reasonably safe navigation at high stages.

The amount expended to June 30, 1893, was $15,207.35, with which a small hand-propelled snag boat was built and employed in the fiscal years 1888 and 1889 in removing obstructions to navigation. In the fiscal year 1891 the snag boat was sold to the work of improving Red River, Louisiana and Arkansas, for $1,500, and the proceeds of the sale, with the appropriation of 1890, were applied to going over the work, removing snags, drift, and leaning trees, practically completing the project for safe navigation at high stages. Under the act of 1892 the largest Red River snag boat was employed in removing obstructions to navigation for a period of seventy days, and found considerable improvement in depth of channel by scour since the previous work. Although the stages during the time it was at work were near extreme low water, the snag boat, 36 feet beam and 30 inches draft, crossed the bars without difficulty. Work was carried from Fulton to the Kiamichi River, and consisted of clearing a safe low-water channel for the passage of the snag boat, that being all that could be done with the small amount available. The channel will scour and widen, but the work is not permanent, as new obstructions are added continually.

No work was done during the fiscal year ending June 30, 1894, as the balance was not sufficient to resume operations.

The commerce of this part of Red River at present is inconsiderable, and until a single appropriation of $10,000 can be granted, to permit the systematic clearing of timber along the banks and removal of the obstructions in the channel, no further work is recommended. This amount can be expended to advantage in one low-water season, and the work would stop accumulations of drift, permit the channel to scour, and benefit navigation below Fulton to a great extent by lessening the source of jams or raft.

July 1, 1893, balance unexpended	$292.65
June 30, 1894, amount expended during fiscal year	2.29
July 1, 1894, balance available	290.36
Amount appropriated by act of August 17, 1894	3,500.00
Amount available for fiscal year ending June 30, 1895	3,790.36
Amount that can be profitably expended in fiscal year ending June 30, 1896 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	10,000.00

(See Appendix V 2.)

3. *Ouachita and Black rivers, Arkansas and Louisiana.*—The improvement of Ouachita River was commenced in 1871. Black River, connecting the Ouachita with Red River, was added under the same head of appropriation by act of 1884. The project under which work has been carried on since 1874 contemplates the removal of snags, logs, wrecks, leaning timber, etc., obstructing navigation, and the improvement of shoal places by dams and dredging, between Camden, Ark., and the mouth of Black River, a distance of 341 miles. No estimate of cost is given, as the nature of the work requires that it be continuous.

The amount expended to June 30, 1893 (including outstanding liabilities of $14.92), was $351,938.94, of which $238,351.07 was applied under the present project. An iron-hull snag boat was purchased in 1875 and repaired with a new steel bottom in 1886, and a small wooden snag boat was purchased in 1888. From 1875 to the end of the fiscal year 1893 operations were carried on whenever funds were available and conditions favorable for work, and consisted chiefly of the removal of snags, logs, wrecks, and tree slides from the channel, and cutting leaning timber, though an increased depth was obtained at some of the shoals by building wing-dams of stone or brush.

During the fiscal year ending June 30, 1894, the snag boat *Wagner* was employed for a period of three months in removing obstructions to navigation between Jack's Island, Ark., and Bayou Louis, La., a distance of 200 miles. At Catahoula Shoals a channel 65 feet wide and 4 feet deep at low water was dredged through that obstruction, requiring the excavation of 29,026 cubic yards of material. This work was stopped by high water, but will be resumed and completed during the low-water season of 1894. A line of precise levels was run from Natchez and Vidalia on the Mississippi to Trinity at the junction of Ouachita, Black, Tensas, and Little rivers, and thence along the Ouachita between Trinity and Monroe. A new hull was purchased for repairing the small wooden snag boat, at a cost of $4,000.

The entire available balance has been allotted to complete the work at Catahoula Shoals, and to fit up the machinery on the new hull of the wooden snag boat.

July 1, 1893, balance unexpended	$30,575.98
June 30, 1894, amount expended during fiscal year	19,709.97
July 1, 1894, balance unexpended	10,866.01
July 1, 1894, outstanding liabilities	8.77
July 1, 1894, balance available	10,857.24
Amount appropriated by act of August 17, 1894	50,000.00
Amount available for fiscal year ending June 30, 1895	60,857.24

Amount that can be profitably expended in fiscal year ending June 30, 1896	$240,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

(See Appendix V 3.)

4. *Bayous D'Arbonne and Corney, Louisiana.*—The project for this improvement, adopted in 1884, contemplated two seasons' work for the removal of snags, logs, wrecks, leaning timber, etc., obstructing navigation from Stein Bluff, on the Corney Branch, to the mouth of D'Arbonne, 42½ miles, at an estimated cost of $15,000. The river and harbor act of 1892 required that $1,000 should be expended for the improvement of the Corney above Stein Bluff to the head of navigation, a distance of 16½ miles.

The amount expended to June 30, 1893, was $10,874.94. Before the improvement commenced the bayou was navigable at high stages for about six to seven months of the year. The work extended the period of navigation fully one month, enabled boats of double the capacity of those used formerly to make quicker time and with greater safety, reduced freight rates one-half, and extended navigation 16½ miles up the Corney Branch.

During the fiscal year ending June 30, 1894, work for the removal of obstructions to navigation commenced at Cobb Landing, the head of navigation on Bayou Corney, and was carried down to mouth of the D'Arbonne. The work was done at the lowest stages, and the removal of stumps and other obstructions from the channel, and leaning timber, not only lessened the danger of navigation, but enabled steamboats to run to Cobb Landing on a stage 2 feet lower than formerly.

The work is not permanent, as new obstructions are added from time to time, but as the original project for benefiting high-water navigation has been completed no estimate is made for continuing the improvement.

July 1, 1893, balance unexpended	$4,125.06
June 30, 1894, amount expended during fiscal year	2,890.51
July 1, 1894, balance available	1,234.55
Amount appropriated by act of August 17, 1894	3,000.00
Amount available for fiscal year ending June 30, 1895	4,234.55

(See Appendix V 4.)

5. *Bayou Bartholomew, Louisiana and Arkansas.*—The project for this improvement, adopted in 1881, contemplated the removal of snags, logs, wrecks, leaning timber, etc., to give safe navigation from the mouth to Baxter, Ark., about 150 miles. The original estimate of cost for two consecutive seasons' work was $26,862, but as new obstructions are added every year no estimate for permanent improvement has been made.

The amount expended to June 30, 1893, was $32,651.90. Operations extended over the entire portion of the bayou between Baxter and the mouth, and some of the worst obstructed reaches were worked over two and three times, but the appropriations were too small to do the work thoroughly as contemplated in the original project. The work done at intervals, however, has benefited navigation to a great extent. Before operations commenced the average duration of the navigable season was three months. The work gave better and safer navigation for about six months; enabled boats of double the capacity to make trips in half the time, and freight rates were reported to have been reduced 50 per cent.

During the fiscal year ending June 30, 1894, work for the removal of obstructions to navigation extended from McCombs Landing, Ark., some 30 miles below Baxter, considered the head of navigation, to the mouth. The stream was found badly obstructed by fallen timber, many of the trees bridging the bayou. The work was done at low stages, rendering navigation comparatively safe at high and medium stages. In the part of the stream below Lind Grove, La., which had been worked over most thoroughly in preceding years, considerable improvement in the depths on bars was noted, the channel having scoured from 4 to 10 inches deeper at shoals where snags and logs had been removed thoroughly.

July 1, 1893, balance unexpended	$5, 348. 10
June 30, 1894, amount expended during fiscal year	4, 314. 03
July 1, 1894, balance unexpended	1, 034. 07
July 1, 1894, outstanding liabilities	. 24
July 1, 1894, balance available	1, 033. 83
Amount appropriated by act of August 17, 1894	5, 000. 00
Amount available for fiscal year ending June 30, 1895	6, 033. 83
Amount that can be profitably expended in fiscal year ending June 30, 1896 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	10, 000. 00

(See Appendix V 5).

6. *Bœuf River, Louisiana.*—The project for improving this river, adopted in 1881, contemplated removing snags, logs, leaning timber, etc., obstructing navigation at high stages between the mouth and Wallace Landing, about 152 miles above, by two consecutive seasons' work, at a cost estimated at $20,000. This amount was appropriated in sums of $5,000 each in a period of six years. As new obstructions are added every year, and require removal from time to time in the interest of safe navigation, no estimate for permanent improvement has been made. The closure of three outlets near Point Jefferson, La., was added to the project in 1886.

The amount expended to June 30, 1893, was $30,839.97, which enabled steamboats to run to Point Jefferson, 19 miles below Wallace Landing, at high stages, with greater safety; and below the Vicksburg, Shreveport and Pacific Railroad bridge they could navigate without danger at any stage high enough to permit them to cross the bars, at a saving of at least thirty-six hours on the round trip. The three outlets were closed, as securely as possible with the means available, in 1887–'88, and the work gave immediate benefit to navigation by confining the flow to its natural course and scouring the bars below, but the dams were destroyed during the overflow from the Mississippi River in the spring of 1890. It is essential that they be rebuilt, and the estimated cost of the work required is $30,000.

During the fiscal year ending June 30, 1894, work for the removal of obstructions to navigation was commenced at the mouth, November 13, and carried upstream to Winters Place, about 10 miles above the Vicksburg, Shreveport and Pacific Railroad bridge, where it was suspended January 8 by high water. The part of the stream worked over was benefited greatly, and put in safe condition for navigation at any stage high enough to permit steamboats to run. The work will be continued upstream as soon as the water falls with reasonable prospect of its remaining low.

July 1, 1893, balance unexpended	$10,160.03
Received on account of overpayment to land-grant railroad	1.45
	10,161.48
June 30, 1894, amount expended during fiscal year	3,956.75
July 1, 1894, balance available	6,204.73
Amount appropriated by act of August 17, 1894	8,000.00
Amount available for fiscal year ending June 30, 1895	14,204.73
Amount that can be profitably expended in fiscal year ending June 30, 1896, including closure of outlets	35,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix V 6.)

7. *Tensas River and Bayou Maçon, Louisiana.*—The project for improving Tensas River, adopted in 1881, contemplated removing snags, logs, and leaning timber obstructing navigation between the mouth and Dallas, about 134 miles above, at an estimated cost of $23,000. Bayou Maçon, a tributary, was added under the same head of appropriation by act of 1884, and the project contemplated removing the same class of work between its mouth and Floyd, about 98 miles above, at an estimated cost of $17,000. The estimates were based upon calculations for continuous work in one low-water season, and, in view of the appropriations made, are without value, as new obstructions are added every year and require removal in the interest of safe navigation from time to time.

The amount expended to June 30, 1893, was $24,424.64, of which $7,529.25 was applied to improving Tensas River and $16,895.39 to Bayou Maçon. With these expenditures Bayou Maçon below Floyd and Tensas River below the entrance of the Maçon were put in fairly good navigable condition, enabling steamboats to make quicker trips into the Maçon, the principal commercial branch, during the navigable season, with comparative ease and safety.

In the past fiscal year Tensas River was worked over December 11, 1893, to January 30, 1894, from its mouth up to Tensas Bluff, ordinarily considered the head of navigation. This work lessened the danger of navigation and enabled boats to make faster time.

Although new obstructions are added from time to time, it is believed that with the balance of the original estimate in one appropriation both streams can be cleared of obstructions so thoroughly as not to need attention for several years.

July 1, 1893, balance unexpended	$1,575.36
June 30, 1894, amount expended during fiscal year	1,575.36
Amount appropriated by act of August 17, 1894	5,000.00
Amount (estimated) required for completion of existing project	9,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	9,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix V 7.)

8. *Big Black River, Mississippi.*—The project for this improvement, adopted in 1884, contemplated clearing a channel suitable for navigation at high stages by the removal of snags, logs, leaning timber, etc., between the mouth and Cox Ferry, about 130 miles above. The cost of completing the work in two seasons was estimated at $32,000, but new obstructions are added each year.

The amount expended to June 30, 1893, was $9,914.07. The first appropriation, $5,000, was applied to removing the principal obstructions from the mouth upstream about 75 miles. The next appropriation, by act of 1886, contained a provision that no portion should be expended until the State of Mississippi caused certain bridges to be so constructed as not to obstruct navigation. The act of 1890 removed the restriction, and in 1891 the funds were applied to work between Baldwin and Ivanhoe ferries, a stretch of about 20 miles No work has been done since.

The funds available will be applied to continuing the removal of leaning timber and snags as soon as the water reaches a low stage.

In view of the small amount of commerce to be benefited, the fact that there is no probability of an increased business for years to come, and the cost of maintaining navigation by the removal of obstructions added every year, no estimate is submitted for continuing this work.

July 1, 1893, balance unexpended	$5,085.93
June 30, 1894, amount expended during fiscal year	280.96
July 1, 1894, balance unexpended	4,804.97

(See Appendix V 8.)

9. *Yazoo River, Mississippi.*—Work in this river commenced in 1873. The project contemplates removing wrecks, snags, logs, leaning timber, etc., obstructing navigation. New obstructions, caused by floods, caving and sliding banks, etc., are brought into the river every year, and no estimate for permanent improvement is given on this account.

The total amount expended to June 30, 1893, was $223,578.40 (including outstanding liabilities of $19.82), part of which was applied to constructing the snag boat *Meigs*, the purchase of a pumping dredge, and to the survey of the mouth and lower river. The benefits derived from the work are marked. The large number of wrecks which obstructed the river and limited the period of navigation, many of which were sunk to prevent passage during the war of the rebellion, were removed so as to present little or no obstruction, and the persistent work of snag boats, carried on whenever funds were available for the purpose, for the removal of snags, logs, leaning timber, etc., gave steamboat navigation from mouth to head at all stages the year round.

During the fiscal year ending June 30, 1894, the snag boat *Meigs* was employed in the season of low water removing obstructions.

More sliding banks were found than at any period within the preceding ten years, and heavy and effective work was done, putting the river in good navigable condition for the time.

Nearly all of the available balance was allotted by act of 1888 for the pumping dredge.

July 1, 1893, balance unexpended	$11,441.42
June 30, 1894, amount expended during fiscal year	8,978.29
July 1, 1894, balance unexpended	2,463.13
July 1, 1894, outstanding liabilities	14.50
July 1, 1894, balance available	2,448.63
Amount appropriated by act of August 17, 1894	20,000.00
Amount available for fiscal year ending June 30, 1895	22,448.63
Amount that can be profitably expended in fiscal year ending June 30, 1896 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	100,000.00

(See Appendix V 9.)

10. Mouth of Yazoo River, Mississippi.—The shifting bar at mouth of Yazoo River is the most serious obstruction to navigation of that river and its main tributaries, a system of about 800 miles. At low stages boats are prevented from entering or leaving the river without lightering, and frequently navigation across the bar is closed entirely. The proposed improvement contemplates making a new outlet from the former mouth of Yazoo, on Old River, through the deep water in Old River, across the neck of low land between Long and Barnett lakes to Lake Centennial, around the head of De Soto Island, and along the front of Vicksburg, entering the Mississippi River on the channel side at Kleinston. The cost of the work is estimated at $1,200,000.

The river and harbor act of 1892 appropriated $75,000 for beginning work, to be applied to obtaining and clearing and grubbing the right of way for the land cut, and to include necessary borings and gaugings. A survey of trial and final lines for location of the canal was made; a line of precise level from Vicksburg to Greenwood, near the headwaters of the Yazoo, and thence to Greenville on the Mississippi, was completed; most of the discharge observations were computed, and all the field work was plotted and the maps were nearing completion at the close of the fiscal year ending June 30, 1893.

During the fiscal year ending June 30, 1894, the maps have been finished, iron and stone pipes sunk at intervals on the east side of the dredged channel in front of Vicksburg, and connected with the system of levels and borings made along the proposed line between Old River and Lake Centennial, extending below the grade of the cut, and the character of material to be encountered determined. The engineer in charge was authorized to enter into negotiations with owners of the lands required for the right of way, but had not been able to report reasonable offers at the end of the fiscal year, and it may be necessary to institute proceedings for condemnation, as provided in the act approved July 13, 1892.

Whether the work shall be done by contract or by purchase of plant and employment of men, the engineer in charge recommends that the full appropriation be made, both for economy of money and to reduce the time required for completion.

Amount of original estimate		$1,500,000.00
Amount of revised estimate		1,200,000.00
Amount required to complete the work		1,125,000.00

July 1, 1893, balance unexpended		$65,580.85
June 30, 1894, amount expended during fiscal year		4,496.06
July 1, 1894, balance unexpended		61,084.79
July 1, 1894, outstanding liabilities		2.00
July 1, 1894, balance available		61,082.79
Amount appropriated by act of August 17, 1894:		
For the cut	$225,000.00	
For Vicksburg Harbor	40,000.00	
		265,000.00
Amount available for fiscal year ending June 30, 1895		326,082.79

Amount (estimated) required for completion of existing project	860,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	635,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix V 10.)

11. Tchula Lake, Mississippi.—This work was commenced in 1881, and the project contemplated removing snags, logs, leaning timber, etc., obstructing navigation, to permit light-draft boats to enter the lake earlier in the season. The estimated cost of removing obstructions was given in 1880 at $10,000, if the work was done in one low-water season. The first appropriation was $3,000, and the total amount of the estimate was not appropriated for eight years. The work is of such nature that it must be gone over to remove obstructions added from time to time, and no estimate for permanent improvement is given on this account.

The amount expended to June 30, 1893, was $15,053.82, with which the greater portion of the leaning timber was cleared, and the principal obstructions removed from the channel, giving greater ease and safety to the passage of steamboats through the lake; but the period of navigation was not prolonged, owing to enlargement of the bars in the lake.

No work was done during the fiscal year ending June 30, 1894, but it is intended to resume operations when the water falls to a low stage.

The unexpended balance and the appropriation made during the present session of Congress will be applied to removing obstructions in the lake.

July 1, 1893, balance unexpended	$2,946.18
July 1, 1894, outstanding liabilities	9.00
July 1, 1894, balance available	2,937.18
Amount appropriated by act of August 17, 1894	3,000.00
Amount available for fiscal year ending June 30, 1895	5,937.18

(See Appendix V 11.)

12. Tallahatchee River, Mississippi.—This improvement was begun in 1879. The project contemplated removing snags, sunken logs, wrecks, leaning timber, etc., obstructing navigation from mouth of the river to its junction with Coldwater River, about 100 miles above. The estimated cost of removing obstructions was given in 1879 at $40,000, if completed in two seasons' work. New obstructions are added each year by sliding and caving banks, the shifting and scouring of the channel exposes others or lodges them upon bars, and no estimate for permanent improvement is given on this account.

The total amount expended to June 30, 1894, was $41,552.56, of which $10,000 was required by law to be expended above mouth of Coldwater, a part of the river in which there has been no navigation since the war, and which was not included in the project for improvement. With the small appropriations made, great benefit to navigation has been obtained between the mouth and Sharkey Landing, about 65 miles above, enabling steamboats to run to that place at all stages the year round. Before the improvement commenced there was navigation for only about six months of the year. Little was done above Sharkey, because the funds available were not sufficient, and because until 1890 the steamboat interest reported that boats would not run above that landing, except to make occasional trips at high stages when navigation was as good and about as safe as in the lower river. No benefit was derived from the work done in 1880, 1881, and 1882 above the mouth of Coldwater to Batesville, required by the terms of appropriations.

In the fiscal year ending June 30, 1894, the snag boat *Meigs* was employed for thirteen days in removing obstructions, chiefly tree slides, of which there was a large number. Operations extended from the mouth up to Cassity Bayou, one-half mile below Sharkey Landing, and put the lower river in good navigable condition for the time, but should be repeated as soon as practicable, to remove obstructions which are adding continually, and the stretch above Sharkey to the mouth of Coldwater should be worked over thoroughly.

The sum of $10,000 can be expended to advantage of commerce and navigation in one season of low water.

July 1, 1893, balance unexpended	$947.44
June 30, 1894, amount expended during fiscal year	937.89
July 1, 1894, balance unexpended	9.55
July 1, 1894, outstanding liabilities	6.50
July 1, 1894, balance available	3.05
Amount appropriated by act of August 17, 1894	4,000.00
Amount available for fiscal year ending June 30, 1895	4,003.05
Amount that can be profitably expended in fiscal year ending June 30, 1896 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	10,000.00

(See Appendix V 12.)

13. Steele and Washington bayous, Mississippi.—The improvement of Steele Bayou commenced under the river and harbor act of 1884. Washington Bayou, about 7 miles long, which connects Steele Bayou with Lake Washington, was added by act of 1886. The project contemplates removing snags, stumps, drift, and leaning timber obstructing high-water navigation.

The amount expended to June 30, 1893, was $10,056.43, with which Steele Bayou was worked over twice from its source in Swan Lake to its mouth, and the obstructions in Washington Bayou were removed in 1886, resulting in greater ease and safety to steamboat navigation, but the work was by no means thorough on account of small appropriations.

No work was done during the fiscal year ending June 30, 1894.

Steamboat navigation of this stream was not commenced until 1879, and since the construction of a railroad through the country in 1884 it has dwindled until there is practically no trade. It is navigable only when the Mississippi is high enough to fill the lower part with backwater, and owing to the uncertainty of navigation there is no probability that the steamboat business will revive. In view of the foregoing, no estimate is made for continuing work.

July 1, 1893, balance unexpended	$2,443.57
June 30, 1894, amount expended during fiscal year	.31
July 1, 1894, balance unexpended	2,443.26

(See Appendix V 13.)

14. Big Sunflower River, Mississippi.—Work in this river commenced in 1879. The project contemplated the removal of snags, sunken logs, and leaning timber obstructing navigation, and building wing dams to scour a channel about 40 inches deep at the bars. The original estimate of cost was $66,000, made with a view to completing the work then required in three or four consecutive seasons of low water. As new obstructions are added from time to time, which should be removed in the interest of safe navigation, no estimate for permanent improvement is given.

The amount expended to June 30, 1893, was $61,302.91. The work extended over the navigable river from the mouth to Clarksdale, though little has been done above Faisonia since 1882, as no benefit would have been gained by improving the upper river and leaving the lower part in an obstructed condition, the appropriations having been too small for work over the whole. It has been the endeavor, therefore, to obtain the best results within the means provided by keeping the lower river open to navigation the year round and extending the limit up stream as the work progresses. Before work commenced the river was navigable for light boats about six months of the year; now it is navigable the year round, but difficult and dangerous at low stages on account of shoals, snags, and sunken logs. Larger boats are used and make the trips in little more than half the time required formerly, and freight rates are said to be 50 per cent less. The lands along the river have been cleared and settled rapidly of late years, which is attributed partly to improved navigation.

No work was done during the fiscal year ending June 30, 1894.

An appropriation of $20,000 can be expended profitably in one season of low water, and will result in greater benefit and work of a more lasting character than can be obtained with a larger sum by small appropriations at intermittent periods.

July 1, 1893, balance unexpended	$697.09
June 30, 1894, amount expended during fiscal year	40.72
July 1, 1894, balance unexpended	656.37
July 1, 1894, outstanding liabilities	13.33
July 1, 1894, balance available	643.04
Amount appropriated by act of August 17, 1894	5,000.00
Amount available for fiscal year ending June 30, 1895	5,643.04
Amount that can be profitably expended in fiscal year ending June 30, 1896 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1896.	20,000.00

(See Appendix V 14.)

15. Big Hatchee River, Tennessee.—This work commenced in 1880. The project contemplated removing snags, logs, leaning timber, etc., to render the stream navigable the year round for light draft boats between the mouth and Bolivar, about 240 miles above. The cost of the work was estimated at $30,000 in 1880, if completed in three consecutive seasons. As new obstructions are added every year, no estimate for permanent improvement is given.

The amount expended to June 30, 1893, was $29,821.52, rendering the stream navigable for light boats from seven to nine months of the year. Before work commenced navigation was virtually suspended by the obstructions.

During the fiscal year ending June 30, 1894, work was not resumed until June, but in that month 14½ miles of river was cleared of obstructions. The available balance will be applied to continuing operations from Rialto down to the mouth, and will put the lower 70 miles of the river in fairly good navigable condition.

The officer in charge reports that the small amount of commerce to be benefited is not commensurate with the cost of continuing this improvement, which opinion is concurred in by this office.

July 1, 1893, balance unexpended	$5,678.48
June 30, 1894, amount expended during fiscal year	2,423.20
July 1, 1894, balance unexpended	3,255.28

(See Appendix V 15.)

16. Forked Deer River, Tennessee.—Work in South Fork of this river commenced in 1883. The river and harbor act of 1888 added North Fork and the main river, under the general title improving Forked Deer River. The project contemplated removing snags, logs, leaning timber, etc., obstructing navigation of South Fork below Jackson, North Fork below Dyersburg, and the main river. The original estimates of cost were $19,250 for South Fork, $4,500 for North Fork, and $7,000 for the main river, based on plans for removing obstructions in one season. New obstructions are added every year, and no estimates for permanent improvement have been made on this account.

The amounts expended to June 30, 1893, were $12,500 for South Fork and $9,500 for North Fork and the main river. The two forks were put in fairly good navigable condition, and the removal of obstructions from the main stream enabled small boats to navigate with greater ease and safety for a period of about eight months of the year. Navigation of South Fork is carried on by flatboats, and before the improvement commenced about one in three was wrecked by the obstructions; now they make the trip with comparative safety at reduced cost. No work has been done in South Fork since 1889. The work in North Fork enabled boats to run to Dyersburg on a stage 3 feet lower than formerly.

The river and harbor act of 1892 provided $3,000 for "completing improvement" of North Fork and main river. During the fiscal year ending June 30, 1894, work commenced May 22 at Dyersburg, was carried down to the mouth of North Fork, and thence down the main stream about 17 miles. The work will be completed early in July.

It is the opinion of the officer in charge that, in view of the limited commerce to be benefited, no further appropriation can be expended profitably for this improvement.

July 1, 1893, balance unexpended	$3,000.00
June 30, 1894, amount expended during fiscal year	2,628.22
July 1, 1894, balance unexpended	371.78
July 1, 1894, outstanding liabilities	2.10
July 1, 1894, balance available	369.68

(See Appendix V 16.)

17. Water gauges on Mississippi River and its principal tributaries.—These gauges were designed to secure information from continuous records, with a view to protecting alluvial lands against overflow, improving navigation, and giving correct reports of the stages of water for the benefit of river men and planters. Their establishment and the maintenance of daily observations were enjoined upon the Secretary of War by joint resolution of Congress, approved February 21, 1871 (Statutes at Large, vol. 16, p. 598). Section 6 of the river and harbor act of 1888 provided a permanent indefinite appropriation for the purpose of securing uninterrupted gauging.

The amount expended to June 30, 1893, was $97,703.90. The 17 gauges ordered by the resolution of February, 1871, were established the latter part of that year, except the one at Carrollton, La., established in January, 1872. Seven additional gauges have been established and 2 discontinued, and there are now 22 gauges maintained. The service has been improved materially of late years. In 1881 bulletins were erected at the stations on the Mississippi for the purpose of giving passing steamboats the stage of water and indicating whether the river was rising, stationary, or falling. In 1890 they were replaced by larger bulletins and the old ones used for extending the service to the tributaries. Since February 1, 1887, the gauges have been read and bulletins posted twice a day, to secure greater uniformity and accuracy; formerly they were read only once a day. The readings have been published by the Mississippi River Commission to end of the calendar year 1893.

July 1, 1893, balance unexpended	$29.81
Amount allotted for fiscal year ending June 30, 1894	5,500.00
	5,529.81
June 30, 1894, amount expended during fiscal year	5,507.35
July 1, 1894, balance unexpended	22.46
July 1, 1894, outstanding liabilities	21.00
July 1, 1894, balance available	1.46
Amount allotted for fiscal year ending June 30, 1895	5,500.00
Amount available for fiscal year ending June 30, 1895	5,501.46
Amount that can be profitably expended in fiscal year ending June 30, 1896 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	12,000.00

(See Appendix V 17.)

IMPROVEMENT OF ARKANSAS RIVER AND OF CERTAIN RIVERS IN ARKANSAS AND MISSOURI.

This district was in the charge of Capt. H. S. Taber, Corps of Engineers, to December 19, 1893, and of Capt. Carl F. Palfrey, Corps of Engineers, since that date; Division Engineer, Col. C. B. Comstock, Corps of Engineers.

1. *Removing obstructions in Arkansas River.*—This river was, previous to improvement, seriously obstructed by snags, overhanging timber, reefs, and bars.

The original project under this head was to raise and destroy snags, cut overhanging timber, remove bowlders and reefs by blasting and dredging, and cut out sand bars by temporary wing dams.

To this was later added the survey of the river, with the view to permanent improvement.

Since appropriations for permanent improvement were made, blasting, dredging, and dams have been omitted from the project, leaving customary snagging operations only.

On this work had been expended, from the first appropriations in 1832 up to June 30, 1893, $829,328.57.

By general consent of masters and pilots this expenditure has resulted in a material alleviation of the difficulties of navigation.

The operations of the fiscal year have been confined to the reach from Little Rock to Dardanelle. They are reported as adding several trips to the running season.

July 1, 1893, balance unexpended	$19,954.89
Received on account of sale of U. S. snag boat *Missouri*	2,500.00
	22,454.89
June 30, 1894, amount expended during fiscal year	21,882.05
July 1, 1894, balance unexpended	572.84
July 1, 1894, outstanding liabilities	135.94
July 1, 1894, balance available	436.90
Amount appropriated by act of August 17, 1894	20,000.00
Amount available for fiscal year ending June 30, 1895	20,436.90

Amount (estimated) required for work annually	$35,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	35,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

(See Appendix W 1.)

2. *Arkansas River*, *Arkansas.*—Besides obstructions by snags, etc., the natural channel is shifting, and obstructed by sand bars fed by caving banks, and also by reefs of rocks in the upper reaches.

Of the earlier appropriations for removing obstructions, $20,000 was allotted to removal of a bar at Fort Smith. Later appropriations were for works at Fort Smith and Pine Bluff, since adopted as part of the general plans of improvement.

Present project is to contract by dikes or by dams closing chutes, so as to give a channel of 6 feet in depth below Little Rock and 2 feet in depth above Little Rock, and to protect this channel by revetment of caving banks.

For the works already constructed, adopted in 1888 as part of the general project, there had been appropriated up to 1886 $128,500, which has been applied to those works. From the appropriation for the general improvement of the river, including allotments therefrom for the above works, there was expended up to June 30, 1893, $545,288.24.

Long reaches of the river are still unimproved. The works above Dardanelle have removed the bar in front of that place. Dikes at various shallow crossings have deepened the channel. Deep water has been held against the river front at Little Rock. The bar above Pine Bluff has been removed, and the caving bank at that city has been protected by revetment.

The expenditures for the fiscal year 1894 have been for consolidation and repair of existing works, except one dike at Crystal Hill, whose effect upon the channel has not yet been tested.

July 1, 1893, balance unexpended	$109,711.76
Received on account of sale of U. S. quarter boats *Yorktown* and *Greenwich*	5,000.00
	114,711.76
June 30, 1894, amount expended during fiscal year	98,835.83
July 1, 1894, balance unexpended	15,875.93
July 1, 1894, outstanding liabilities	479.68
July 1, 1894, balance available	15,396.25
Amount appropriated by act of August 17, 1894	250,000.00
Amount available for fiscal year ending June 30, 1895	265,396.25
Amount (estimated) required for completion of existing project	2,972,479.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	250,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

(See Appendix W 2.)

3. *Fourche Le Fevre River*, *Arkansas.*—This stream was obstructed by snags, drift racks, and overhanging timber, and also by shoals of rock and gravel.

The adopted project was for the usual snagging operations and removal of shoals by blasting and dredging.

On this project has been expended, up to June 30, 1893, $32,508.50.

A channel to Perryville, navigable for light-draft boats at a stage of the Arkansas River reading 6 feet on the Signal Service gauge at Little Rock, has been secured.

There have been no operations in the field during the fiscal year 1894.

July 1, 1893, balance unexpended	$4,491.50
June 30, 1894, amount expended during fiscal year	3,071.46
July 1, 1894, balance unexpended	1,420.04
July 1, 1894, outstanding liabilities	5.00
July 1, 1894, balance available	1,415.04

(See Appendix W 3.)

4. *Petit Jean River, Arkansas.*—This stream was obstructed by snags, drift racks, overhanging timber, and by rocky shoals.

The original project (1886) was for the usual snagging operations to Danville, 45 miles.

Additional project (1888, completed in 1891) was for removal of a portion of ledges at Slaty Crossing and Robinsons Ridge. On this work had been expended, up to June 30, 1893, $6,007.50.

Under this project a navigable channel had been cleared to Rocky Crossing, 18 miles.

During the fiscal year 1894, the clearing has been extended to Danville, Ark., completing the original project as regards the present condition, no results of snagging being more than temporary.

July 1, 1893, balance unexpended	$3,492.50
June 30, 1894, amount expended during fiscal year	3,306.84
July 1, 1894, balance unexpended	185.66
July 1, 1894, outstanding liabilities	8.00
July 1, 1894, balance available	177.66

(See Appendix W 4.)

5. *White River, Arkansas.*—Before improvement, this river was obstructed by snags, overhanging timber, and shoals.

The adopted project includes the usual snagging operations, blasting, and dredging, and the contraction of the channel by wing dams.

Under this project there had been expended, from appropriations for this river and for separate reaches of it, up to June 30, 1893, $247,198.49. This has resulted in material improvement of navigation.

The operations of the fiscal year 1894 have been snagging and the construction of 6 dikes. The snagging has been an aid to navigation. The effect of the dikes has not yet been reported.

July 1, 1893, balance unexpended	$48,801.51
June 30, 1894, amount expended during fiscal year	40,756.65
July 1, 1894, balance unexpended	8,044.86
July 1, 1894, outstanding liabilities	501.69
July 1, 1894, balance available	7,543.17
Amount appropriated by act of August 17, 1894	*52,000.00
Amount available for fiscal year ending June 30, 1895	59,543.17
Amount (estimated) required for completion of existing project	36,815.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	30,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

(See Appendix W 5.)

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* Of this amount $2,000 may be used in Cache River in the discretion of the Secretary of War.

6. *Cache River, Arkansas.*—In its original condition this channel was obstructed by snags, overhanging timber, and shoals.

The project provides for the usual snagging operations.

On this work there had been expended, up to June 30, 1893, $9,825.58.

This expenditure had resulted in obtaining a fair channel to James Ferry, about 78 miles above the mouth.

The operations of the fiscal year 1894 have extended the channel to the White and Black River Valley Railway bridge, about 86¾ miles from the mouth, and also in removing fallen timber below James Ferry, which had resulted from a storm in June, 1893.

July 1, 1893, balance unexpended	$1,174.42
June 30, 1894, amount expended during fiscal year	1,062.41
July 1, 1894, balance unexpended	112.01
July 1, 1894, outstanding liabilities	4.00
July 1, 1894, balance available	[*]108.01
Amount that can be profitably expended in fiscal year ending June 30, 1896	5,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix W 6.)

7. *Black River, Arkansas and Missouri.*—Before improvement this river was obstructed by snags, overhanging timber, and shoals.

The adopted project has been for snagging operations and the closing of chutes by dams.

On this project had been expended from the separate appropriations made for this river up to June 30, 1893, $71,897.32. This expenditure has rendered navigation easier.

Operations of the fiscal year 1894 have been snagging in two bad bends, leaving the river clear as far as the mouth of Current River, about 149 miles.

July 1, 1893, balance unexpended	$3,602.68
June 30, 1894, amount expended during fiscal year	2,498.27
July 1, 1894, balance unexpended	1,104.41
July 1, 1894, outstanding liabilities	52.00
July 1, 1894, balance available	1,052.41
Amount appropriated by act of August 17, 1894	9,500.00
Amount available for fiscal year ending June 30, 1895	10,552.41
Amount (estimated) required for work annually	8,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	8,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix W 7.)

8. *Current River, Arkansas and Missouri.*—The report upon which the appropriation of August 17, 1894, for this work is based was made to comply with the requirements of the river and harbor act of September 19, 1890. The examination was made under the direction of Capt. H. S. Taber, Corps of Engineers, and the report, dated December 11, 1890, of results was submitted to Congress and printed in House Ex. Doc. No. 157, Fifty-first Cong., second session; also in annual report of this office for 1891, pages 2065–'71. The plan of improvement recom-

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[*] Of the appropriation made for White River, Arkansas, by the river and harbor act of August 17, 1894, $2,000 may, in the discretion of the Secretary of War, be expended in removing obstructions in Cache River.

mended consisted of removing snags and overhanging trees, building wing dams, and contemplated building and equipping one small hand-propelled snag boat, at a total estimated cost of $10,000.

Amount appropriated by act of August 17, 1894	$8,000.00

Amount (estimated) required for completion of existing project	2,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	2,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

9. St. Francis River, Arkansas.—This river was, prior to improvement, obstructed by snags, drift, overhanging timber, and shoals.

The adopted project has been for the usual snagging operations.

Under this project there has been expended from the separate appropriations made for this river, $31,752.47.

This has resulted in amelioration of the difficulties of navigation.

The operations of the fiscal year 1894 have been working twice over the reach between Madison and Marked Tree, about 122 miles in length.

July 1, 1893, balance unexpended	$4,247.53
Received on account of deposit made by Capt. H. S. Taber	.16
	4,247.69
June 30, 1894, amount expended during fiscal year	3,795.12
July 1, 1894, balance unexpended	452.57
July 1, 1894, outstanding liabilities	50.00
July 1, 1894, balance available	402.57
Amount appropriated by act of August 17, 1894	*8,000.00
Amount available for fiscal year ending June 30, 1895	8,402.57

Amount (estimated) required for work annually	8,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	8,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix W 8.)

10. St. Francis River, Missouri.—Before improvement this section of river was obstructed by snags and overhanging timber.

The project for its improvement provides for the usual snagging operations.

Under this project there had been expended up to June 30, 1893, $15,516.01. This expenditure had resulted in some relief to navigation.

No operations have been carried on during the fiscal year 1894. Of the balance remaining, $2,000 is held for purchase, under provisions of the river and harbor act of September 19, 1890, of the cut-off canal owned by the Dunklin County Transportation Company.

July 1, 1893, balance unexpended	$2,983.99
June 30, 1894, amount expended during fiscal year	802.56
July 1, 1894, balance unexpended	2,181.43
July 1, 1894, outstanding liabilities	5.00
July 1, 1894, balance available	2,176.43
Amount appropriated by act of August 17, 1894	5,000.00
Amount available for fiscal year ending June 30, 1895	7,176.43

(See Appendix W 9.)

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* In addition to this sum, $75,000 is appropriated by the act of August 17, 1894, to be expended under the Mississippi River Commission, for the prevention of the formation of a cut through to the St. Francis River by the action of the overflow water from the Mississippi River.

REMOVING SNAGS AND WRECKS FROM MISSISSIPPI RIVER; IMPROVEMENT OF MISSISSIPPI RIVER BETWEEN THE OHIO AND MISSOURI RIVERS, OF HARBOR AT ST. LOUIS, MO., OF GASCONADE AND OSAGE RIVERS, MISSOURI, AND OF KASKASKIA RIVER, ILLINOIS.

This district was in the charge of Maj. Charles J. Allen, Corps of Engineers, with Lieut. Chester Harding, Corps of Engineers, under his immediate orders, since May 3, 1894; Division Engineer, Col. C. B. Comstock, Corps of Engineers.

1. *Removing snags and wrecks from Mississippi River.*—Before this work was inaugurated the navigation of the river was very much interfered with by numerous snags, logs, etc., which had lodged in the channel, and to which a new accession was brought down on each rise of the river, thus constantly adding new and unknown obstructions to those already there. A large number of wrecks, dangerous to navigation, also occupied the channel.

For the removal of these obstructions appropriations were made as early as 1824, and the project adopted consisted in building boats suitable for removing the snags, etc., and operating them whenever the stage of water was favorable for the work, and funds were available.

The total amount expended for this purpose can not be definitely given, as previous to the appropriation made by act of March 3, 1879, a general amount was appropriated to be applied to several streams as their needs required. From March 3, 1879, when the first specific appropriation was made, up to June 30, 1893, $930,758 had been expended for this purpose. This expenditure materially improved the navigation of the river and lessened the danger to boats. During the fiscal year ending June 30, 1894, the sum of $88,116.22 was expended upon the improvement. Two snag boats were employed in removing the obstructions to navigation between the mouth of the Missouri River and New Orleans.

The boats worked a total of sixteen months, removing 3,057 snags, cutting down 22,861 trees, removing 19 drift piles, and 5 wrecks, and traveling a total distance of 15,336 miles.

The work accomplished during the year has been of great benefit to navigation and commerce. Formerly the wrecking of steamboats from running against snags was of frequent occurrence, but since the snag boats have been regularly at work such wrecks have been seldom heard of.

The boats were thoroughly overhauled during the past spring, and necessary repairs made to them.

An annual appropriation, not to exceed $100,000, for carrying on this work, was made by the act of August 11, 1888. Under this appropriation the two snag boats will patrol the river, and remove obstructions whenever necessary for them to do so.

Amount drawn under section 7, act of August 11, 1888	$100,000.00
June 30, 1894, amount expended during fiscal year	88,116.22
June 30, 1894, outstanding liabilities	136.24
June 30, 1894, amount to revert to the Treasury	11,747.54
July 1, 1894, amount available for fiscal year 1894–'95	100,000.00

(See Appendix X 1.)

2. *Mississippi River between Ohio and Missouri rivers.*—The original condition of the navigable channel of this portion of the Mississippi River, before the work of improvement was begun, was such that the natural depth at low water was in many places from 3½ to 4 feet. The

channels were divided by islands which formed sloughs and secondary channels, through which a good deal of the volume of flow was diverted to the detriment of navigation.

The first work for improvement began in 1872, and was continued for a number of years as appropriations were made, the works consisting of dikes and dams of brush and stone, erected with a view to confining the low-water volume to a single channel, and of revetments to hold and preserve the banks where necessary or advisable to do so.

The present project is a continuation of the plan adopted in 1881, and contemplates reduction of the river width approximately to 2,500 feet below St. Louis, the natural width being in many cases from 1 to 1½ miles. The method employed is the building up of new banks, out to the line desired, from the solid matter brought down by the river and which is collected by means of hurdles. The banks, both new and old, are revetted where necessary.

The object of the improvement is to obtain a minimum depth, at standard low water, of 6 feet from the mouth of the Missouri to St. Louis and of 8 feet from St. Louis to the mouth of the Ohio.

The amount expended to include June 30, 1893, was $4,364,570.32, and the result of the work was that but little difficulty was experienced through the improved portions, and then only at extreme low water. For stages of water above 4 feet on the St. Louis gauge there was generally a depth of at least 6 feet in the channel, excepting at Pulltight, which will be referred to further on.

The amount expended during the past fiscal year was $825,919.86, which resulted in further improvement of the channel.

A persistent bar at Pulltight, about 9 miles below St. Louis, and upon which in the fall of 1892 there was but 4½ feet depth at standard low water, was improved so as to afford a depth of at least 8 feet at the same stage. The work of improvement carried on during the year was as follows:

At Horsetail, just below St. Louis, 2,845 feet of bank protection was partly completed on the west side and a series of 7 hurdles, aggregating 4,340 linear feet, built on the east side.

Head of Carrolls Island to Jim Smith's.—This reach of river is about 9 miles long, and embraces the localities known as Carrolls Island; Twin Hollows, east and west; Pulltight; Chesley Island; and Jim Smith's. The work done was as follows:

At Carrolls Island, 4 hurdles built, aggregate length 2,160 feet.

Twin Hollows, east.—Minor repairs and extensions of the revetment built in 1882 and years following; 9,420 square feet of new revetment built.

Twin Hollows, west.—Hurdles were extended and repaired, and 6 hurdles, aggregating 2,410 feet in length, were built.

Pulltight.—Seven hurdles, of an aggregate length of 6,645 feet, built, 1 hurdle extended 750 feet, and some extensions made of existing hurdles.

Chesley Island.—The new bank formed by hurdles behind the island was protected and the revetment at head of island completed, and that on east bank of island repaired.

Rush Tower.—This reach, which extends from the head of Calico Island to Brickey's Mill, 37½ miles below St. Louis, includes a number of detached works, viz: Protection of west side of the island; hurdles on east side near James Landing; hurdles on west side below Kennett's Castle; bank protection from Osborne Field to Durfee's Landing; hurdles below Durfee's, and works projected for regulating the river at Fish Bend. None of these works have been completed.

Work in this reach during the fiscal year consisted in repair of hurdle No. 3, on west side, between Kennett's Castle and Perry Towhead, and in 1,970 feet of extension of the bank protection, Osborne Field to Durfee's, though this extension was not entirely completed.

Fort Chartres.—This reach, extending from Brickey's Mill to the head of Turkey Island, 43 miles below St. Louis, includes protection of the left bank below Sycamore Landing and a series of hurdles to close the chute west of Bruce Island.

The work of the season in this reach consisted principally in extension of the bank protection 3,750 feet, and in building 6 new hurdles of an aggregate length of 9,375 feet at Bruce Island.

The total of construction work done during the year is as follows:

	Linear feet.
Hurdle built	25,520
Hurdle repaired	1,400
Bank protection (revetment) built complete	632
Bank protection (revetment) partly built, including extensions and repairs	21,235

Considerable new floating plant was also built.

The original estimated cost of the work, as revised in 1883, is $16,397,500.

Of the works constructed to date it may be said that they have been of great benefit to navigation.

July 1, 1893, balance unexpended		$1,023,763.01
June 30, 1894, amount expended during fiscal year		825,919.86
July 1, 1894, balance unexpended		197,843.15
July 1, 1894, outstanding liabilities	$28,459.12	
July 1, 1894, amount covered by uncompleted contracts	69,022.07	
		97,481.19
July 1, 1894, balance available		[*]100,361.96
Amount appropriated by sundry civil act of August 18, 1894		758,333.33
Amount available for fiscal year ending June 30, 1895		858,695.29
Amount (estimated) required for completion of existing project		10,250,833.34
Amount that can be profitably expended in fiscal year ending June 30, 1896		758,333.33
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.		

(See Appendix X 2.)

3. *Harbor at St. Louis, Mo.*—St. Louis Harbor is about 18 miles long and divided into two nearly equal parts by the Eads bridge. The upper part, included between the bridge and the northern limits of the city, is about 10 miles in length.

Three miles above the Eads bridge is the Merchants bridge. The lower part of the harbor, included between Eads bridge and River Des Peres, is 8 miles long. The channel in this part of the harbor has sufficient depth and accessible landings at all points. Good depth exists above the Merchants bridge.

Congress, by act approved September 19, 1890, appropriated $182,000 for this harbor.

The navigable reach between the Eads bridge and Merchants bridge was at that time obstructed by a number of middle bars. The project adopted for improvement of the harbor under the appropriation of 1890 consisted in a contraction of the waterway between those bridges to a width of about 2,000 feet, in order to concentrate the flow upon the bars and thus cause scour to the depth desired. The contraction works consisted of a series of hurdles extending out from the Illinois shore, the object of the hurdles being to collect deposits of material brought down during floods and thus build up a new bank to the line desired.

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[*] Of this amount but $60,515.22 is at present available for the works now in progress, $39,846.74 being allotted for special work at Ste. Genevieve, Cape Girardeau, and Cairo.

This work, which was accomplished by the close of the fiscal year ending June 30, 1892, caused extensive deposits of sediment along the line of hurdles, and has resulted in considerable increase in channel depth, with corresponding benefit to navigation. Soundings made in December, 1893, when the river stood at zero of the gauge, showed a navigable depth of 11 feet in the improved channel.

Amount expended upon the work to July 1, 1893, $150,530.21.

The small expenditure during the last fiscal year was for the usual low-water survey.

The full amount of the estimate for improvement of this part of the harbor has been appropriated. With the balance remaining it is proposed to repair damage that may occur to the hurdles from ice and drift and to extend them wherever found necessary to do so.

July 1, 1893, balance unexpended	$31,469.79
July 30, 1894, amount expended during fiscal year	231.82
July 1, 1894, balance unexpended	31,237.97
July 1, 1894, outstanding liabilities	230.04
July 1, 1894, balance available	31,007.93

(See Appendix X 3.)

4. *Gasconade River, Missouri.*—The navigation of this stream, before its improvement was undertaken by the Government, was seriously obstructed by snags, logs, and leaning timber, and at times almost suspended on account of numerous shoal crossings. Snags are liable to be found after every flood, which also carries more or less drift. The latter is apt to be deposited at the shoals or at other points, causing trouble to rafts and steamers.

Improvement by the Government began in 1880. The project adopted contemplated the removal of snags and logs from the channels, and of leaning timber from the banks of the river when necessary, and construction of wing dams and training walls to concentrate the flow of water upon the shoal crossings.

The amount expended, to include June 30, 1893, was $47,639.40, which resulted in quite generally freeing the river of snags and leaning timber from its mouth to Arlington, a distance of 116 miles.

Amount expended during the past fiscal year, $2,018.95, which resulted in completing the removal of snags and trees over the distance named.

The sum of $10,000, is estimated for the fiscal year ending June 30, 1896, to be expended in continuing removal of obstructions and in building wing dams where necessary.

July 1, 1893, balance unexpended	$2,860.60
June 30, 1894, amount expended during fiscal year	2,018.95
July 1, 1894, balance unexpended	841.65
July 1, 1894, outstanding liabilities	12.00
July 1, 1894, balance available	829.65
Amount appropriated by act of August 17, 1894	[*]5,000.00
Amount available for fiscal year ending June 30, 1895	5,829.65

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[*] To be expended by the Missouri River Commission.

Amount that can be profitably expended in fiscal year ending June 30, 1896	$10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix X 4.)

5. *Osage River*, *Missouri*.—The project for improvement of this stream, adopted in 1871, has consisted in removal of obstructions to navigation, as snags and leaning timber, and in deepening channels over shoals by means of dredging, and construction of cross and wing dams to concentrate the flow of water over shoal places. The first efforts were expended in an attempt to deepen the water over the shoals by dredging. After this the method consisted in construction of wing dams and training walls, to regulate the width of waterway for the low-water discharge of the river. Snags and other obstructions found in the channel were also removed, and leaning timber was cut from the banks.

Before improvement of the river was undertaken by the Government, the channels were so obstructed by snags, trees, and shoals as to make navigation precarious at high stages of water and almost impossible in some portions of the river at low-water stage. Every high stage of water carries more or less snags into the channel, besides causing scour of banks, resulting in new obstructions which have to be removed.

The amount expended to June 30, 1893, was $215,573.50, which resulted in benefiting the navigation from the mouth to Osceola, Mo., a distance of about 230 miles. The lower 60 miles of the river were the most benefited.

The amount expended during the past fiscal year was $3,639.25. This resulted in further improvement and in clearing the river of obstructions from its mouth to Mill Shoal, about 15 miles above Osceola.

Construction of a lock and dam near the mouth of the river was authorized by the river and harbor act of September 19, 1890. The land for the lock was condemned during the year.

The sum estimated for the fiscal year ending June 30, 1896, is to be applied as follows: To removal of obstructions, $10,000; to construction of lock and dam, $55,000.

July 1, 1893, balance unexpended	$94,426.50
June 30, 1894, amount expended during fiscal year	3,639.25
July 1, 1894, balance unexpended	90,787.25
July 1, 1894, outstanding liabilities	744.22
July 1, 1894, balance available	90,043.03
Amount appropriated by act of August 17, 1894	[*]46,000.00
Amount available for fiscal year ending June 30, 1895	136,043.03

Amount (estimated) required for completion of lock and dam	64,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	65,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix X 5.)

6. *Kaskaskia River*, *Illinois*.—The original condition of this river was such that navigation at low water was almost if not entirely suspended by reason of snags, shoals, and bars, and depended to a great extent, as to its duration, on the stage of water in the Mississippi River. The least depth found, when the St. Louis gauge read 6.5 feet, was 9 inches

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[*] To be expended by the Missouri River Commission.

over what is called the "Nine-Mile Shoal," 6 miles above its mouth, which virtually "blocked" the river at low water. At high water navigation was possible as far up as New Athens.

The first appropriation for improving the river was in 1890, and the project adopted for its improvement consisted in excavating a channel through the shoals of such depth as would insure a low-water navigation of 36 inches, and in the removal of snags and obstructions from the channel, at an estimated cost of $10,500. Congress, by act of September 19, 1890, appropriated $6,000 for the improvement. A further appropriation of $4,500 was made by the act of July 13, 1892.

The amount expended upon the improvement to the close of the fiscal year ending June 30, 1893, was $9,108.11. The result of the expenditure was the excavation of a channel 75 feet wide and 36 inches deep at low water at Nine Mile Shoal, and a channel 60 feet wide and 34 inches deep at Evansville Shoal, the excavated rock having been utilized in constructing dikes to concentrate the flow of water in the cuts. A large number of snags, trees, rack heaps, and logs, and several rocks were also removed from the stream between Baldwin bridge and Cox's Ferry. This work was of great benefit to the commerce of the river.

Amount expended during the fiscal year ending June 30, 1894, $1,352.69.

The work of the fiscal year under the small balance available consisted in further removal of obstructions from the channel at Evansville and Nine-Mile Shoals and from the river between those shoals, the length of stream worked over being about 8 miles. The dikes constructed in 1891 were also repaired. This work correspondingly increased the facilities for navigation, and the result of all the work done to date is that steamboats are enabled to navigate this stream at lower stages and for low-water seasons of greater length than formerly was the case.

The full amount of the original estimate having been appropriated, no further appropriation is here asked for.

July 1, 1893, balance unexpended	$1,391.89
June 30, 1894, amount expended during fiscal year	1,352.69
July 1, 1894, balance unexpended	39.20

(See Appendix X 6.)

IMPROVEMENT OF MISSISSIPPI RIVER BETWEEN MOUTH OF MISSOURI RIVER AND MINNEAPOLIS, AND OF GALENA RIVER, ILLINOIS.

This district was in the charge of Maj. A. Mackenzie, Corps of Engineers, with Lieut. William V. Judson, Corps of Engineers, under his immediate orders; Division Engineer, Col. O. M. Poe, Corps of Engineers.

1. *Operating snag boats and dredge boats on Upper Mississippi River.*—At the beginning of the fiscal year there was available, under act of August 11, 1888, the sum of $25,000.

On July 1 and 2, from July 10 to October 28, 1893, and from April 5 to June 30, 1894, the snag boat *General Barnard* was employed removing snags and other obstructions and assisting interests of navigation between Minneapolis and the mouth of the Missouri River.

The snag boat *J. G. Parke* was loaned during the year to the general improvement and was employed on construction work.

The total amount expended for snag-boat service on the Upper Mississippi River between Minneapolis and the mouth of the Missouri River to June 30, 1893, is $649,640.

By the river and harbor act of August 11, 1888, provision was made for operating snag boats and dredge boats on the Upper Mississippi River under a permanent appropriation, the sum so expended not to exceed $25,000 annually.

The total amount of freight transported on the Upper Mississippi River during the calendar year 1893 was, approximately, 3,200,000 tons.

The amount expended during fiscal year ending June 30, 1894, was $25,000.

(See Appendix Y 1.)

2. *Mississippi River between Missouri River and Minneapolis.*—At the beginning of the fiscal year there was available for improvement work between the limits mentioned, under acts of July 13, 1892, and March 3, 1893, the sum of $937,287.45. Under this appropriation is carried on the improvement of through navigation.

Work has been in progress under approved projects since 1878, and very favorable results have been secured, showing that with a continuance of the work under liberal appropriations the low-water channel of the Mississippi River between St. Paul and the Missouri River can be made comparatively deep, available, and permanent. The interests for which the improvement is being made are very large and important. The amount of freight carried during 1893, including the logs and lumber floated in the river, aggregated, approximately, 3,200,000 tons.

The original condition of the channel between the Missouri River and St. Paul was such that in low stages the larger boats were unable to proceed farther up the river than La Crosse or Winona; and in many seasons, at points much lower down, their progress was checked or seriously hindered. In all such cases through freight was reshipped on small and light-draft boats or barges. The originally adopted project for the improvement, which has not been materially changed, proposed the contraction of the channel or waterway by means of wing and closing dams to such an extent as, by means of the scour thereby caused, to afford a channel of sufficient width, and of a depth of 4.5 feet at low water, to be eventually increased to 6 feet by further contraction.

There was expended on the permanent improvement of through navigation to June 30, 1893, the sum of $4,077,029.12, or $5,631.25 per mile. At that date, and for several years previous, the condition of the channel was such as to permit the passage of the largest boats at very low stages through to St. Paul.

During the past year work has been carried on by day's labor and use of Government plant between St. Paul and Lake Pepin; between Minneiska and Genoa; at Rock Island Rapids; between Keithsburg and Montrose; between Quincy and Clarksville, and between the Illinois and Missouri rivers; and by contract between Smiths Bar and Lake Pepin; between Genoa and Prairie du Chien; between Glenhaven and Dubuque; between Dubuque and Clinton; between Keokuk and Quincy; at Quincy Bay; between Quincy and Hannibal; between Clarksville and Hamburg; between Hamburg and Cap au Gris, and between Cap au Gris and the mouth of the Illinois River. The work of the year has resulted in increased width and depth of channel wherever operations were carried on.

July 1, 1893, balance unexpended		$1,217,846.20
June 30, 1894, amount expended during fiscal year		924,386.78
July 1, 1894, balance unexpended		293,459.42
July 1, 1894, outstanding liabilities	$10,623.16	
July 1, 1894, amount covered by uncompleted contracts	141,902.05	
		152,525.21
July 1, 1894, balance available		140,934.21
Amount appropriated by sundry civil act of August 18, 1894		866,666.67
Amount available for fiscal year ending June 30, 1895		1,007,600.88
Amount that can be profitably expended in fiscal year ending June 30, 1896 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.		866,666.67

(See Appendix Y 2.)

3. *Des Moines Rapids, Mississippi River.*—This work was commenced in 1867. The adopted plan provided for the building of a closed canal 8 miles long, and for cutting an open channel in the rock bed of the river over the remaining 4 miles of rapids. The canal was opened in August, 1877, and has been in operation since that time. Several patches of rock above grade in the open canal were removed, which completed the approved project and exhausted the appropriation. There has been appropriated and allotted for this work the sum of $4,574,950. The net cost to the United States has been, to the time of its completion, $4,560,361.82.

July 1, 1893, balance unexpended	$2,681.45
June 30, 1894, amount expended during fiscal year	2,681.45

(See Appendix Y 3.)

4. *Operating and care of Des Moines Rapids Canal and Dry Dock.*—During the past year the Des Moines Rapids Canal was open for navigation 238 days, during which time there passed through it 619 steamboats and 312 barges, carrying 14,752 passengers, 43,182 tons of merchandise, and 83,650 bushels of grain. There also passed through the canal 117,360,783 feet, B. M., of lumber, and 42,112,415 lath.

The dry dock was in constant use during the whole year.

The cost of operating and care of the canal is provided for by an indefinite appropriation made by act of March 3, 1881.

The amount expended during the year was $55,356.48.

(See Appendix Y 4.)

5. *Operating and care of Galena River improvement, Illinois.*—This improvement, consisting of a lock and dam in the Galena River, was purchased by the United States in March, 1894, under provisions of act of Congress of September 19, 1890, at a cost of $100,000. The United States took possession on March 12, 1894, and the lock was in operation from that date—except during high water—to the close of the fiscal year.

There passed through the lock 167 steamboats and barges, carrying 1,426 passengers and 1,228 tons of merchandise.

The cost of operating and care of the canal is provided for under an indefinite appropriation made by act of Congress approved July 5, 1884.

The amount expended during the year, was $635.68.

(See Appendix Y 5.)

IMPROVEMENT OF MISSISSIPPI RIVER ABOVE FALLS OF ST. ANTHONY, MINNESOTA; OF RIVERS IN WISCONSIN AND MINNESOTA TRIBUTARIES TO MISSISSIPPI RIVER, AND OF RED RIVER OF THE NORTH, MINNESOTA AND NORTH DAKOTA; GAUGING MISSISSIPPI RIVER AT ST. PAUL.

This district was in the charge of Maj. W. A. Jones, Corps of Engineers; Division Engineer, Col. O. M. Poe, Corps of Engineers.

1. *Mississippi River above Falls of St. Anthony, Minnesota.*—The project was adopted in 1875. The river was divided into 3 sections. First section, Falls of St. Anthony to St. Cloud, 78 miles, improvement to be by wing dams and dredging; estimated cost, $144,667.50. Second section, St. Cloud to Conradi Shoal, 42 miles; improvement to be by wing dams, removal of bowlders, and 4 locks and dams; estimated cost, $1,957,785.75. Third section, Conradi Shoals to Grand Rapids, 217 miles, improvement to be by dredging, removal of bowlders, and wing dams; estimated cost, $54,127.50. Total, $2,156,578.75. In 1889, the estimate for improving the upper 130 miles of the third section was placed at $63,000.

The first two appropriations (those of 1874 and 1876) aggregating $45,000, were expended upon the first section, but steamboat navigation having been discontinued over that reach, the third appropriation was applied to the upper 130 miles (Aitkin to Grand Rapids) of the third section, as were also the appropriations of 1881, 1882, and 1888. In 1890 Congress appropriated $18,000 for the completion of the improvement between Aitkin and Grand Rapids, as recommended in the annual report of 1889. This amount was expended and accomplished the desired object, and also extended the improved channel from Aitkin to Brainerd, 55 miles. Before improvement the stream between Aitkin and Grand Rapids was so obstructed that navigation was difficult and at times almost impossible for steamers of lightest draft.

Total expenditures to June 30, 1893, including outstanding liabilities, were $45,000 on first section and $62,994.77 on upper 180 miles of third section. There is now a general depth of 3 feet at low water in the channel above Brainerd. This result, although not the 5 feet called for in the project, is sufficient for all present navigation requirements. In dry seasons the three completed reservoirs at headwaters of Mississippi River may be relied upon to furnish sufficient water and depth for boats above Brainerd.

There being no demand at present for navigation between the Falls of St. Anthony and Brainerd, no further appropriation is now asked for. The opening, during the winter of 1889-'90, of the Duluth and Winnipeg Railroad from Duluth to the Mississippi River has resulted in a decrease of steamboat traffic. But one steamboat now runs on the river, and she is not operated regularly.

July 1, 1893, balance unexpended	$15.58
June 30, 1894, amount expended during fiscal year	8.18
July 1, 1894, balance unexpended	7.40
July 1, 1894, outstanding liabilities	7.40

(See Appendix Z 1.)

2. *Reservoirs at headwaters of Mississippi River.*—The object of the reservoirs is to collect surplus water, principally from the precipitation of winter, spring, and early summer, to be systematically released so as to benefit navigation on the Mississippi River below the dams. The

reservoir project is the outcome of surveys and examinations made in 1869, 1874, 1878, and 1879. From the results of these examinations and further examinations made in 1880 the first cost of constructing reservoir dams in Minnesota and Wisconsin was placed at $1,809,083. The cost of land and other damages to result from construction and operation of the proposed dams was not included in that estimate, as they could not be predicted with any approach to accuracy.

The present project consists in constructing reservoir dams at headwaters of the Mississippi River in Minnesota, that locality having been selected for commencing the work in consequence of an appropriation made by the river and harbor act approved June 14, 1880, for construction of a reservoir dam at Lake Winnibigoshish, Minnesota, and for other reasons given in Appendix Y to the Annual Report for 1886. By 1886 four of the reservoirs had been created. In the spring of 1891 the construction of a fifth reservoir at Sandy Lake was commenced, and one-half was built by the fall of 1892, but its completion has been delayed by the provision in the river and harbor act of Congress, July 13, 1892, providing for a navigable pass in the dam. Plans embodying the modifications were drawn and submitted to a Board of Engineers for examination and report. The Board approved the plans with one modification, and the work is now in progress.

The total expenditures on this work to the close of the fiscal year ending June 30, 1893, including examinations at proposed dam sites, land damages, amounts paid to commissioners in attempted settlements of awards to Indians, and care and maintenance of the works, were $727,799.67.

During the past year the operations have been operating completed reservoirs, continuing construction of Sandy Lake Dam. In the office maps of the reservoir watersheds were prepared and the hydrological and meteorological data were tabulated.

The reservoirs were operated in 1885–'93 during the seasons of low water to the benefit of navigation on more than 165 miles of the Mississippi River, viz, between Grand Rapids and Aitkin, 130⅛ miles, and from St. Paul to some distance below the confluence of the Mississippi and St. Croix rivers.

It is recommended that the reservoir system be placed under the operation of the statute which provides a permanent appropriation for the care, operation, and maintenance of completed structures which benefit commerce and navigation.

The officer in charge recommends appropriations aggregating $130,000 for the completion of the Sandy Lake reservoir dam, construction of the Gull Lake reservoir and dam, and for hydrological and meteorological observations to precisely determine the effect of reservoir water.

July 1, 1893, balance unexpended	$55, 550. 17
June 30, 1894, amount expended during fiscal year	50, 277. 59
July 1, 1894, balance unexpended	5, 272. 58
July 1, 1894, outstanding liabilities	1, 866. 25
July 1, 1894, balance available	3, 406. 33
Amount appropriated by act of August 17, 1894	51, 000. 00
Amount available for fiscal year ending June 30, 1895	54, 406. 33
Amount (estimated) required for completion of existing project	983, 683. 50
Amount that can be profitably expended in fiscal year ending June 30, 1896	115, 000. 00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893

(See Appendix Z 2.)

3. *Chippewa River, including Yellow Banks, Wisconsin.*—The plan for improvement of the Chippewa River consists in revetment of caving bends and construction of dams and jetties from Eau Claire to the confluence of the Chippewa and Mississippi, a distance of 57 miles, to confine the low-water volume to a channel of nearly uniform width and depth. The general plan was adopted in 1877, and the work has been carried on in accordance with it, varying, however, more or less as to location and extent of dams, jetties, etc. The protection of the Yellow Banks consists in a revetment of piling and fascines, the latter to be crowned with rock. The object of the Yellow Banks protection is to prevent their erosion and thus relieve the channel of the Chippewa River and of the Mississippi below the junction of the two streams from the masses of sand contributed by those banks. The plan for protecting the banks was adopted in 1883. The improvement of the river and the protection of the Yellow Banks were regarded as separate and distinct works until the act of August 11, 1888. The original estimate of cost as made in 1875 was $139,892.50. The last revision of the estimate, made in 1888, placed the cost at $272,487.72.

Before the improvement commenced the depth on the bars at low water seldom exceeded 18 inches, and the crossing at the mouth of the river was extremely difficult at that stage, owing to the volume of the river joining the Mississippi through a number of channels of insufficient depth. These latter-named channels were contracted into one of good depth by means of long parallel jetties. Generally, wherever works of improvement were constructed by the Government, the low-water depths were increased from 18 inches to 3 or 4 feet, and the general improvement not only greatly facilitated the passage of steamers and rafts, but also greatly reduced the expense of rafting manufactured lumber. Localities remaining to be improved have a least depth in the channel of about 2 feet.

No work, except slight repair, has been done at the Yellow Banks since 1883, when 4,978 linear feet of bank revetment had been completed, and the piling for 3,275 feet had been driven ready for the backing of brush and stone.

The total expenditures from the commencement of operations in 1877 to June 30, 1893, including outstanding liabilities, were $171,022.76.

During the past year the injuries, resulting from ice dams, to the recently constructed dam at Eau Galle Flats were repaired. The dam has had a marked effect on the channel over the Eau Galle Flats. Rafts are now able to pass without trouble.

July 1, 1893, balance unexpended	$1,125.56
June 30, 1894, amount expended during fiscal year	1,075.82
July 1, 1894, balance unexpended	49.74
July 1, 1894, outstanding liabilities	49.74
Amount appropriated by act of August 17, 1894	10,000.00
Amount (estimated) required for completion of existing project	90,737.72
Amount that can be profitably expended in fiscal year ending June 30, 1896	60,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix Z 3.)

4. *St. Croix River, Wisconsin and Minnesota.*—The original project and original estimate for this improvement were based upon a survey made in 1874, when the river was at a high stage of water and but comparatively few obstructions to be seen. It contemplated removal of

snags, bowlders, sand bars, etc., and contraction of low-water channels from Taylor Falls to the confluence of the river with the Mississippi into one of nearly uniform width. Estimated cost, $21,758. At low water, however, the channel had in many places but 2 feet depth, and steamers and barges made their way as best they could among the obstructions; at times it was impossible for them to get over the shoal places. Following a low-water survey made in 1879, the estimate was revised in 1880, 1882, and 1889. The last aggregated $129,700.

The total expenditures to June 30, 1893, including outstanding liabilities, were $106,012.21.

The effect of the work of improvement has been to secure a least depth of 3 feet on the improved bars above Stillwater and 4 to 5 feet on the bars below that place. Generally, it may be said of this improvement that at many points navigation has been rendered permanent where formerly it was uncertain, and that in other places it has been made practicable where, before improvement, it was impossible.

In the improved parts of the river above Stillwater there is a low-water depth in the channel of 2 feet; below Stillwater there is a good channel with a least depth of 4 feet.

The work of improvement during the last year has consisted in dredging in the channel over Hudson Bar. The work at Hudson enabled the raft boats with their large tows to more easily make the run over the bar.

July 1, 1893, balance unexpended	$2,828.95
June 30, 1894, amount expended during fiscal year	2,823.36
July 1, 1894, balance unexpended	5.59
July 1, 1894, outstanding liabilities	5.59
Amount appropriated by act of August 17, 1894	4,000.00
Amount (estimated) required for completion of existing project	14,200.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	14,200.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix Z 4.)

5. *Minnesota River, Minnesota.*—From 1867 to 1873 Congress appropriated $77,500 for improving the Minnesota River. The appropriations were applied to removing snags and bowlders, so as to afford a least depth at low-water stage of 2 to 3 feet. In 1874 a survey was made from the mouth of the river to South Bend, a distance of about 116 miles, to determine the practicability of improving the navigation by means of canals, locks, and dams. Based upon this survey, estimates were made for five locks and dams, and removal of snags, etc., at a cost of $733,868.63, the cost of removing snags, etc., being therein placed at $34,585.10, including contingencies. Following this report, Congress made three appropriations of $10,000 each, by acts approved March 3, 1875, August 14, 1876, and June 18, 1878, which sums were applied to clearing the river of obstructions below South Bend.

The expenditures to June 30, 1879, were $117,457.

From 1879 to 1893 no work for improvement of the river has been undertaken. Under the appropriations above named, the removal of obstructions cleared the way over long stretches of the river between Minnesota Falls and a point about 30 miles below Henderson (16.7 miles above Shakopee). Little or no use was made of the cleared channels, as there was not sufficient water in the channel to permit navigation during low-water periods. The rapidly caving banks on the upper section of this stream cause snags and leaning trees to form, so that channels that were cleared of them thirteen years ago are more or less encumbered with them to-day.

Amount expended to June 30, 1893, including outstanding liabilities, $117,644.99.

Previous to the fall of 1893 no expenditures had been made for the improvement of the lower part of the river, which affords much better facilities for river traffic than the upper part.

From Shakopee to the Mississippi the river is deep except on two bars. There are few snags on this reach.

The river and harbor act of August 11, 1888, appropriated $10,000 for improving the Minnesota River, including the protection of the banks opposite the borough of Belle Plaine. It appearing, from an examination made in September, 1888, that the sum was inadequate for the purposes named, its expenditure for work of improvement was deferred until the further wishes of Congress in the matter might be known.

The river and harbor act of July 13, 1892, made the sum available for the improvement of the river, omitting the requirement for operations at Belle Plaine. It was expended during September, October, and November, 1893, at the mouth in closing the main outlet of the river, by a dam of brush and stone and dredging a channel through the Fort Snelling chute. This plan of improvement was adopted in order to take advantage of the fall, during low stages, of 1½ feet between the Mississippi and Minnesota rivers at Fort Snelling. The improvement, when permanently completed, will raise during low water the pool from Shakopee to the mouth (24 miles) 1½ feet, and will extend navigation to the lower end of the town of Carver, 30 miles above the mouth. Owing to the incomplete state of the improvement at the mouth the long continued high water of last spring damaged the work to a considerable extent. No funds are now available for continuing the improvement.

July 1, 1893, balance unexpended	$9,873.55
June 30, 1894, amount expended during fiscal year	9,283.05
July 1, 1894, balance unexpended	590.50
July 1, 1894, outstanding liabilities	16.50
July 1, 1894, balance available	574.00
Amount (estimated) required for completion of existing project	693,868.63
Amount that can be profitably expended in fiscal year ending June 30, 1896	100,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix Z 5.)

6. *Red River of the North, Minnesota and North Dakota.*—The project for improvement of this river from Breckenridge to the northern boundary line, adopted in 1877, modified in 1887, and amended as to cost in 1883, 1887, and 1893, consists in removal of snags, leaning trees and bowlders, and in dredging channels through the bars, at an estimated cost of $307,320.

Before improvement the ruling depth on the bars between Moorhead and Goose Rapids at ordinary low water was but 1½ feet, and below Grand Forks 2 feet, while between Moorhead and Abercrombie the navigation was at all times difficult.

The work to June 30, 1893, has resulted in opening a channel 3 feet deep at ordinary low water and 60 feet wide from Moorhead to Grand

Forks, except a stretch of 15 miles at and near upper end of Goose Rapids, and a 4-foot channel at low water, 60 feet wide, from Grand Forks to the boundary line; also in the removal of snags and trees between Moorhead and Abercrombie so as to afford a safe passage for steamers between those points during high and medium stages of water.

The total amount expended, including outstanding liabilities, to June 30, 1893, was $234,828.29.

Dredging operations were confined during the past fiscal year to the first twenty-four days in July, in which time the improvement on Goose Rapids Flats was completed. This extended the dredged channels 1 mile.

July 1, 1893, balance unexpended	$7,960.50
July 30, 1894, amount expended during fiscal year	7,607.44
July 1, 1894, balance unexpended	353.06
July 1, 1894, outstanding liabilities	250.76
July 1, 1894, balance available	102.30
Amount appropriated by act of August 17, 1894	15,000.00
Amount available for fiscal year ending June 30, 1895	15,102.30
Amount (estimated) required for completion of existing project	52,320.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	52,320.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix Z 6.)

7. *Gauging Mississippi River at or near St. Paul, Minn.*—The Board of Engineers to whom was referred the project for the application of $37,500 appropriated by the river and harbor act of August 5, 1886, for reservoirs at head waters of Mississippi River, recommended in their report, dated May 24, 1887, "that such gaugings be made at or near St. Paul during the annual operation of the reservoirs as shall determine accurately the discharge at that point at critical periods." (P. 1692, Annual Report Chief of Engineers, 1887.)

The river and harbor act of August 11, 1888, authorized the gaugings, and provided for them as follows:

> And the Secretary of War shall cause such gaugings to be made at or near St. Paul during the annual operation of said reservoirs as shall determine accurately the discharge at that point, the cost of the same to be paid out of the annual appropriation for gauging the waters of the Mississippi River and its tributaries.
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> * * * * * * *
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> SEC. 6. That for the purpose of securing the uninterrupted gauging of the waters of the lower Mississippi River and its tributaries, as provided for in joint resolution of the twenty-first of February, eighteen hundred and seventy-one, upon the application of the Chief of Engineers, the Secretary of War is hereby authorized to draw his warrant or requisition from time to time upon the Secretary of the Treasury for such sums as may be neccessary to do such work, not to exceed in the aggregate for each year the amount appropriated in this act for such purpose: *Provided, however,* That an itemized statement of said expenses shall accompany the Annual Report of the Chief of Engineers.

Gaugings were not made until the fall of 1889, although an allotment of $900 for the fiscal year ending June 30, 1889, had been made. On account of the lateness in the season and the condition of the river it was not deemed advisable to expend any of the money that year.

The allotments of $600, $900, $900, $500, and $500, made for the fiscal years 1889–'90, 1890–'91, 1891–'92, 1892–'93, and 1893–'94 were applied to gauging the Mississippi River at St. Paul and, when necessary, the Minnesota River at its mouth.

During the past fiscal year 159 gaugings have been made.

July 1, 1893	$113.99
Amount allotted for fiscal year ending June 30, 1894	500.00
	613.99
June 30, 1894, amount expended during fiscal year	592.06
July 1, 1894, balance unexpended	21.93
July 1, 1894, outstanding liabilities	21.93
Amount allotted for fiscal year ending June 30, 1895	500.00

(See Appendix Z 7.)

IMPROVEMENT OF MISSOURI RIVER ABOVE SIOUX CITY, IOWA, AND OF YELLOWSTONE RIVER, MONTANA AND NORTH DAKOTA.

This district was in the charge of Capt. Harry F. Hodges, Corps of Engineers; Division Engineer, Col. O. M. Poe, Corps of Engineers.

1. *Missouri River between the Great Falls, Montana, and Sioux City, Iowa.*—Between the Great Falls and Fort Benton, 37 miles below, the channel is unnavigable, being obstructed by rocks and having a very steep slope. No effort has ever been made to improve it and none is contemplated.

Between Fort Benton and Carroll, 168 miles below, the river has fairly stable banks and a gravelly or rocky bed. The difficulties in navigation are due to the shallow water and steep slope on certain ripples, and to rocks in the channel. The low-water depth was originally less than 30 inches.

Below Carroll the river becomes muddy, with unstable banks and a shifting channel. The difficulties in navigation are chiefly due to sand bars, to snags, and to the width of the river, which is so great in places as to leave little available depth.

The minimum low-water depth changes from year to year with the shifting bars. It was originally sufficient to maintain a considerable commerce.

The approved project contemplates a detailed topographical survey from Fort Benton to Sioux City, the removal of bowlders and construction of cut-off and wing dams between Fort Benton and Carroll, and the removal of snags and similar obstructions and the construction of two ice harbors between Carroll and Sioux City. Rectification work at Pierre and Yankton has been authorized by Congress, but is not yet projected, as no funds are available for it.

The present project dates from the appropriation of 1882. Up to June 30, 1893, a sum of $673,443.43 had been spent in carrying it out. Before its adoption a sum of about $230,000 had been spent in surveys and local work under no general project.

The results of this expenditure were as follows: Above Carroll the principal obstructions had been removed and the worst shoals deepened, giving a low-water depth of 30 inches at the improved places and making the channel much easier to run. Further work was suspended, navigation having ceased on this reach.

Below Carroll a fleet of three snag boats had been organized and put at work removing obstructions, the place for one ice harbor had been selected at Rockhaven, N. Dak., and the plans prepared.

The field work of the survey, extending over 1,477 miles of river, had been nearly finished, the plotting about three-fourths finished, and the printing begun.

The expenditures in the year ending June 30, 1894, have resulted as follows:

The field work of the survey has been finished and the printing about three-fifths finished. About one-fourth of the work on the ice harbor at Rockhaven has been done. The site for the second harbor has been fixed at the mouth of the Big Sioux River, and a project for the construction has been prepared.

One snag boat has been enlarged and fitted with steam propelling power.

The high-water discharge of the river has been measured at Sioux City and the low-water discharge at various points, and the necessary gauges have been maintained.

The plant has been cared for and kept in repair.

No work has been done on the river above Carroll; the expenses of the snag boats have been defrayed chiefly from the special appropriation for their maintenance.

December 9, 1893, received, refundment of overpayment	$45.48
July 1, 1893, balance unexpended	160,127.47
	160,172.95
June 30, 1894, amount expended during fiscal year	67,108.47
July 1, 1894, balance unexpended	93,064.48
July 1, 1894, outstanding liabilities	17,092.44
July 1, 1894, balance available	75,972.04
Amount appropriated by act of August 17, 1894	[*]110,000.00
Amount available for fiscal year ending June 30, 1895	185,972.04
Amount that can be profitably expended in fiscal year ending June 30, 1896	[†]500,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

(See Appendix AA 1.)

2. *Removal of snags and other obstructions in Missouri River above Sioux City, Iowa.*—The approved project contemplates the use of the available funds in the work stated on that part of the Missouri River above Sioux City where boats may be running and where it is most needed.

But one appropriation has been made for this work, that by the sundry civil act of March 3, 1893, $50,000.

The fleet of three snag boats which had been maintained from the general appropriation for improving the river has been operated during the year from this special appropriation. Their aggregate time was equivalent to 309 working days for one boat. The total results were 1,035 snags removed or destroyed, 60 miscellaneous obstructions removed, 1,842 trees cut on caving banks, and 5,175 miles of river passed over. The largest of the boats was extensively repaired and altered during the winter and spring.

July 1, 1893, balance unexpended		$50,000.00
June 30, 1894, amount expended during fiscal year		45,483.59
July 1, 1894, balance unexpended		4,516.41
July 1, 1894, outstanding liabilities	$3,390.19	
July 1, 1894, amount covered by uncompleted contracts	1,126.22	
		4,516.41
Amount (estimated) required for work annually		50,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896		50,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

(See Appendix AA 2.)

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[*] Between Stubbs Ferry, Mont., and Sioux City.

[†] Exclusive of $50,000 annually for removal of snags, etc.

3. Examination of Missouri River between Three Forks and Canyon Ferry, Mont., to determine availability of water power.—The river and harbor act approved July 13, 1892, appropriated $2,500 for an examination of Missouri River from Three Forks to Canyon Ferry, Mont., with a view of determining at what points, if any, use might be made of water power for manufacturing and other purposes, without unreasonably impairing the navigability of that portion of the river. The examination was made by the engineer officers in local charge and the report thereon was made by Capt. H. F. Hodges, Corps of Engineers, January 22, 1894, and transmitted to Congress and printed in House Ex. Doc. No. 96, Fifty-third Congress, second session. A copy is also submitted with this report as Appendix AA 3.

Seven sites for dams for water power were located and surveyed and a description of them is given in the report. There is at present no navigation on this portion of the river, but it could probably be made available for boats drawing 30 inches were there a demand commensurate with the cost. Lateral canals around the dams are proposed to provide for future navigation and the dam sites are located with a view to such constructions. In order to secure the interests of navigation the construction and location of the dams should be under the supervision and approval of the War Department.

By act of Congress approved June 8, 1894, the Missouri River Power Company was authorized to construct a dam across the Missouri River, about 2 miles below Stubbs Ferry.

July 1, 1893, balance unexpended		$2,500.00
May 31, 1894, deposited credit Treasurer United States	$754.01	
June 30, 1894, amount expended during fiscal year	1,745.99	
		2,500.00

(See Appendix AA 3.)

4. Yellowstone River, Montana and North Dakota.—Originally the channel of the river was so obstructed by rocks, swift rapids, sharp turns, and insufficient depth at bars as to be nearly impassable to any vessels at low water.

The original project contemplated rock removal at various points of the river and the construction of closing dams and wing dams at some places below Glendive. A survey was also projected.

Up to June 30, 1892, a total of $103,029.13 had been expended on the improvement and $19,000 on the survey. The result has been to give a navigable channel of 3 feet in depth at the points improved above Glendive and 3 feet or more at the points improved below that place. The survey has been finished. During the year ending June 30, 1893, no work has been done. As a large percentage of available funds would be required simply to initiate work, and for the reason that there is no present or prospective demand for aid by navigation, the project is suspended for further action of Congress. There was formerly a brisk river traffic. There is none now.

July 1, 1893, balance unexpended	$11,720.87
June 30, 1894, amount expended during fiscal year	.29
July 1, 1894, balance unexpended	11,720.58
July 1, 1894, outstanding liabilities	.17
July 1, 1894, balance available	11,720.41

(See Appendix AA 4.)

IMPROVEMENT OF OBION RIVER, TENNESSEE, AND OF CUMBERLAND RIVER, TENNESSEE RIVER ABOVE CHATTANOOGA AND BELOW BEE TREE SHOALS, AND THEIR TRIBUTARIES, TENNESSEE AND KENTUCKY.

This district was in the charge of Capt. John Biddle, Corps of Engineers; Division Engineer, Col. C. B. Comstock, Corps of Engineers.

1. *Obion River*, *Tennessee.*—This stream is a tributary of the Mississippi and flows wholly within the State of Tennessee. It rises in the western part of that State, runs in a southwesterly direction, and has a length of about 75 miles. An examination was made in 1880, and a survey was made in 1891 under provisions of river and harbor act approved September 19, 1890, from Obion to the mouth of the river (68.8 miles), the river in this distance having a fall of 27 feet.

The obstructions were found to be heavy drift, snags, overhanging trees, and a tortuous channel.

The project consists of removing surface obstructions, constructing wing dams at the worst shoals, straightening the channel by cutting through several sharp "bends," making the "cut-offs" sufficiently wide and deep by clearing, grubbing, and excavating, closing the old channel by means of pile and brush dams, to secure a navigable channel not less than 3 feet deep at lowest stages, estimated to cost $50,000.

The appropriation of $7,500 in river and harbor act of July 13, 1892, was the first made for this work by the General Government.

The total amount expended, including outstanding indebtedness, to the close of the fiscal year ending June 30, 1893, was $5,466.99, which has resulted in securing a greatly improved channel between Obion and Lane Ferry, Tenn., a distance of about 22 miles, by clearing away snags, drift gorges, and overhanging trees.

In May, 1893, a small steamboat worked up from Fleischhauer mills with two barges of lumber, etc., in tow, the first boat to ascend this stream during fifty years.

Channel work was carried on during the fiscal year in September, October, and November. A stretch of about 20 miles below Obion was again cleared of surface obstructions, thus securing safe navigation. A small steamboat is now plying upon the Obion.

The amount expended during the fiscal year was $1,797.69.

July 1, 1893, balance unexpended	$2,045.01
June 30, 1894, amount expended during fiscal year	1,797.69
July 1, 1894, balance unexpended	247.32
July 1, 1894, outstanding liabilities	12.00
July 1, 1894, balance available	235.32
Amount appropriated by act of August 17, 1894	7,500.00
Amount available for fiscal year ending June 30, 1895	7,735.32
Amount (estimated) required for completion of existing project	35,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	10,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

(See Appendix B B 1.)

2. *Tennessee River—a. Above Chattanooga, Tenn. (188 miles).*—This section of the river extends from the mouth of the French Broad River to Chattanooga, and is usually navigable during the winter and spring months. Examinations were made in 1830 and 1871, and a detailed instrumental survey in 1891-'93. The obstructions were

described as "low-water obstructions," consisting of reefs, rock, or gravel bars, and snags, etc., brought down by freshets. The depth of these bars varies from 10 to 30 inches at a low-water stage, the current being from 2½ to 6 miles per hour.

The original project, under which the work is still carried on, was to blast a channel through the reefs, reduce the gravel and sand bars, and to deepen the water on the bars by the construction of wing dams, thus contracting the waterway so as to secure a safe, navigable channel 3 feet in depth at average low water.

The report, with estimates, of the "careful and comprehensive survey" made in compliance with the river and harbor act of September 19, 1890, was rendered February 23, 1893, and is printed in House Ex. Doc. No. 252, Fifty-second Congress, second session, and in Report of Engineers, 1893, page 2333 *et seq.* The project therein submitted is practically the same as that now in force, providing for a 3-foot low-water navigation between Chattanooga and mouth of French Broad River, by channel excavation, and the construction of wing dams to contract the waterway at low water, at an estimated cost of $650,000.

The amount expended, including outstanding indebtedness, to June 30, 1893, was $291,944.05, which expenditure has resulted in securing a lengthened season of navigation for steamboats and a safer channel for the passage of rafts and flatboats. Of the 43 obstructions enumerated in 1830, channel work has been carried on to the extent of improving at least 29 of them. Owing to the character of the banks these improvements are practically permanent. At White Creek Shoals the longitudinal dam has been lengthened and two spur dams built, causing the removal of the sand bar. At Soddy Shoals the channel has been cleared of surface obstructions, new dams built and old dams strengthened, and good progress made in drilling and blasting the rock ledges or reefs forming this obstruction. At Caney Creek Shoals the building of riprap dams was begun.

During a part of July of the present fiscal year work upon the dams was continued at Caney Creek Shoals, but the stage of water remaining too high to permit of carrying on work to advantage, the working force was transferred to the French Broad River. It not being deemed advantageous with the limited funds available to resume operations late in the season, the boats, etc., were dropped down to Chattanooga for winter moorings as a measure of economy.

The amount expended during the fiscal year was $5,823.41.

July 1, 1893, balance unexpended	$8,567.58
June 30, 1894, amount expended during fiscal year	5,823.41
July 1, 1894, balance unexpended	2,744.17
July 1, 1894, outstanding liabilities	97.07
July 1, 1894, balance available	2,647.10
Amount appropriated by act of August 17, 1894	50,000.00
Amount available for fiscal year ending June 30, 1895	52,647.10
Amount (estimated) required for completion of existing project	600,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	65,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

b. Below Bee Tree Shoals, Alabama (225 miles).—This section of the river is generally navigable during the greater part of the year, though several obstructions render navigation difficult during the low-water season.

No instrumental survey has been made of this section of the river, nor estimates and project submitted for its improvement, and it is very necessary that such a survey be made to obtain data whereon to base estimates and a project for the improvement of the Lower Tennessee. The work required to be done is channel excavation and construction of wing dams to widen, straighten, and deepen the channel at the principal obstructions.

Livingston Point, Kentucky.—The river and harbor acts of September 19, 1890, and July 13, 1892, each appropriated $25,000 for the preservation of Livingston Point, Kentucky, which, with two small islands, forms Paducah Harbor, at the mouth of the river. The plan of improvement adopted consisted in covering the wearing slopes of the banks with a revetment of stone and brush and the construction of a pile-and-stone dike along the crest of the weakest part of the point, where the Ohio cuts through at high stages of the river.

The amount expended, including outstanding indebtedness, to June 30, 1893, was $24,423.59. This expenditure secured the construction of the dike on the Ohio side for a distance of 660 feet across the wash-out near the extremity of the point. The bank protection covers a length of 2,330 feet, the average width being 47 feet. A revetment of brush and stone, about 2,090 cubic yards, was built on the Ohio bank to prevent its washing away. The above specified work was done under contract.

During the fiscal year, the work under contract for the protection of the Ohio bank was continued from July to September; about 7,365 cubic yards of stone and brush being placed in position. The contract was closed November 9, in accordance with its terms. On examination, it was found that the Tennessee bank was also wearing away and must be protected without delay. Authority was asked and granted to revet the Tennessee bank with riprap; about 9,117 cubic yards of stone was thus placed in position during August and September, 1893, and January, 1894; the work was done by purchase of stone in open market, delivered in place on bank.

Total amount expended, including outstanding indebtedness, during the fiscal year was $23,804.68.

The money statement is included in that for improving Tennessee River below Chattanooga, p. 284.

(See Appendix B B 2.)

3. *Hiwassee River, Tennessee.*—This stream rises in the Blue Ridge in North Carolina and Georgia. It flows in a west-northwesterly direction, and enters the Tennessee River about 35 miles above Chattanooga and 148 miles below Knoxville. On examination made in 1874, the channel was found to be obstructed by rock reefs, gravel bars, snags, and overhanging trees.

The present project consists in narrowing the waterway at the shoal places by building wing dams and excavating the reefs and gravel bars and removing surface obstructions so as to secure a channel 40 feet wide and 2 feet deep at ordinary low water from Savannah Ford to the mouth of the river, about 43 miles.

The amount expended to June 30, 1893, including outstanding indebtedness, was $36,449.89, and has resulted in a partial improvement of the river, securing an increased depth in channel and the removal of surface obstructions, principally below Charleston. Active operations were suspended in September, 1892, the funds available for channel work being then exhausted.

No appropriation was made by the river and harbor act of July 13, 1892, for the Hiwassee River.

July 1, 1893, balance unexpended	$73.15
June 30, 1894, amount expended during fiscal year	.22
July 1, 1894, balance unexpended	72.93
July 1, 1894, outstanding liabilities	23.04
July 1, 1894, balance available	49.89

(See Appendix B B 3.)

4. *French Broad River, Tennessee.*—This stream rises on the western slopes of the Blue Ridge in North Carolina, and enters the State of Tennessee at Paint Rock, and after a course of 121 miles in that State joins the Holston, 4½ miles above Knoxville, thus forming the Tennessee River. By examinations made in 1871 and 1875 the river was found to be obstructed by rock reefs, sand and gravel bars, and surface obstructions, such as bowlders, snags, and overhanging trees. It was not deemed practicable to improve the river above Leadvale, but from this point to the mouth, a distance of about 90 miles, it is projected to remove all surface obstructions, and by excavation and use of wing dams to secure for this distance a channel depth of 2½ feet at ordinary low water. Above the mouth of Nolichucky River (Leadvale) to the boundary line of Tennessee and North Carolina a system of locks and dams is the only feasible improvement, but the amount of commerce does not warrant such an expenditure.

The amount expended to June 30, 1893, including outstanding indebtedness, was $52,523.48. This expenditure has resulted in the improvement of ten of the principal obstructions below Dandridge, by deepening and clearing the channel, constructing and modifying wing dams and revetting the banks where necessary. At Seven Island Shoals the improvements have made upstream navigation possible at lower stages of the river. A general deepening of the channel from 6 to 10 inches has been obtained. At Bryant Shoals navigation has been greatly improved; at Hanging Rock Shoals the channel has been changed from the north to the south side of Brabson Island, and the new channel was cleared of obstructions without detention of boats; eight dams were built aggregating a length of 2,694 linear feet, and old dams repaired. The work done has proved effective.

During the fiscal year channel work was continued and consisted in excavating rock at Nichols Reef; building check dam and 180 feet of spur dam, repairing and extending old dams, and revetting bank at Hanging Rock Shoals; building riprap dam at Denton Shoals; strengthening old dams and building new spur dam from right bank just below Zimmerman Ford.

The amount expended during the fiscal year, was $10,968.75.

The engineer officer in charge reports that $150,000, the estimate of 1876, is wholly inadequate to do the work projected, and recommends that a detailed survey be made to obtain the data necessary to determine the cost.

July 1, 1893, balance unexpended	$11,330.08
June 30, 1894, amount expended during fiscal year	10,968.75
July 1, 1894, balance unexpended	361.33
July 1, 1894, outstanding liabilities	31.63
July 1, 1894, balance available	329.70
Amount appropriated by act of August 17, 1894	*6,000.00
Amount available for fiscal year ending June 30, 1895	6,329.70

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[*] Of the appropriation of $7,000 made by the river and harbor act of August 17, 1894, for improving French Broad and Little Pigeon rivers, $6,000 has been allotted to the French Broad River.

Amount (estimated) required for completion of existing project	$82,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	31,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix B B 4.)

5. *Little Pigeon River, Tennessee.*—Little Pigeon River is formed by the junction of its East Fork and South Fork at Sevierville, in east Tennessee, flows in a northwesterly direction for about 5 miles, and empties into the French Broad River about 32 miles above Knoxville. The stream is obstructed by rock and gravel shoals and rapids, and the object of its improvement would be to facilitate navigation during medium and higher stages.

An examination of the river was made under the provisions of river and harbor act of September 19, 1890, and the reports thereon were printed as House Ex. Doc. No. 159, Fifty-first Congress, second session, and as Appendix E E 8, Annual Report, Chief of Engineers, 1891.

The river and harbor act of July 13, 1892, provided that of the $15,000 appropriated for improving French Broad River, $1,000 "may be used in removing the bar or shoal in Little Pigeon River." This sum has been allotted for the removal of the bar near the mouth of the river, described as the only bad shoal below Catlettsburg. The work of reducing the obstructive character of the shoal below Catlettsburg was begun in October at Gass Reef by removing about 90 cubic yards of rock from the channel and placing the same in riprap dam. The large dam in slough just above the mouth of river was repaired, and 3 small dams built across the small slough on the left bank, thus holding up the water in mouth of river and flooding the shoal above.

The amount expended during the fiscal year was $633.10.

July 1, 1893, balance unexpended	$1,000.00
June 30, 1894, amount expended during fiscal year	633.10
July 1, 1894, balance unexpended	366.90
Amount appropriated by act of August 17, 1894	*1,000.00
Amount available for fiscal year ending June 30, 1895	1,366.90

Amount (estimated) required for completion of existing project	8,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	8,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix B B 4.)

6. *Clinch River, Tennessee.*—This stream rises in the Cumberland Mountains in Virginia, and after following a southwesterly course empties into the Tennessee River at Kingston, 104 miles above Chattanooga. About 230 miles of the river flows in the State of Tennessee.

An examination was made in 1875, when the channel obstructions were found to be rock reefs, sand and gravel bars, snags, and overhanging trees.

The present project provides for channel excavation, removing surface obstructions, and the construction of wing dams, so as to secure a safe navigable channel of 2 feet at ordinary low water from mouth of river to Clinton, about 70 miles, and of 1½ feet from Clinton to Haynes or Walkers Ferry, about 75 miles; but from Haynes to the Tennessee State line, 85 miles, the only work practicable is to remove the loose rock and reduce the rock ledges, thus to assist flat boat navigation during "rain tides."

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*Of the appropriation of $7,000 made by the river and harbor act of August 17, 1894, for improving French Broad and Little Pigeon rivers, $1,000 has been allotted to Little Pigeon River.

The engineer officer in charge reports that $50,000, the estimate of 1885, is wholly inadequate to do the work projected, and recommends that a detailed survey be made to obtain the data necessary to determine the cost.

The total amount expended to the close of the fiscal year ending June 30, 1893, including outstanding indebtedness, was $35,806.26, and has resulted in securing a reduction of the rock reefs, the removal of snags, drift, etc., brought down by the annual floods, and the construction of several heavy riprap dams above and below Haynes. A safe channel was secured at stages of the water from 2 to 3 feet lower than before the improvements were begun. Special advantages in the lower river have been gained at Cloud Shoals, Hibb Shoals, Black Shoals, Bletcher Shoals, and at Llewellyn Shoals. At the last-named obstruction safe navigation is reported possible at a stage of water from 1 foot to 1½ feet lower than before the work of 1892 was begun. Some improvements were also made in 1892 in the channel at Youngs Island. Above Haynes improvements were made at Hunter Shoals, Sycamore Shoals, Hopson Shoals, and Straight Shoals.

Partial examinations were made below the mouth of Powell River, and later below the mouth of Emory River, to ascertain in part what is necessary to be done to improve the channel and obtain a navigable 2-foot low-water depth.

No channel work was practicable during the present fiscal year until November, when a little work was done by building a riprap dam near Givens Ford, about one-half mile below mouth of Emory River.

The amount expended during the present fiscal year was $904.28.

July 1, 1893, balance unexpended	$3,222.58
June 30, 1894, amount expended during fiscal year	904.28
July 1, 1894, balance unexpended	2,318.30
July 1, 1894, outstanding liabilities	28.84
July 1, 1894, balance available	2,289.46
Amount appropriated by act of August 17, 1894	2,500.00
Amount available for fiscal year ending June 30, 1895	4,789.46
Amount (estimated) required for completion of existing project	8,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	8,500.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

(See Appendix B B 5.)

7. Cumberland River, Tennessee and Kentucky—a. Below Nashville (191 miles).—An examination was made of this section in 1871, and the channel was found to be of the same general character throughout its entire length and obstructed by rock reefs, bowlders, gravel, and sand bars, snags, and overhanging trees.

The original project provides for the removal of the surface obstructions and deepening the channel by excavation and the building of wing dams. This project was modified in 1888, on the recommendation of a Board of Engineer Officers, by the proposed construction of a pile dike, with crib superstructure for the improvement of the channel at the mouth of the river, from Smithland to the deep waters of the Ohio, for which Congress made provision in river and harbor act of September 19, 1890. A survey was made in 1889, having in view a project for the radical improvement of the river below Nashville and "to ascertain if necessary to establish locks and dams." The river and harbor act of July 13, 1892, provided for the selection and purchase of sites for a lock and dam near the mouth of Harpeth River. This forms the initial movement for work under the modified project, which now consists (first) of the extension of the lock and dam system of the Upper Cumberland to the river below Nashville, the plan being the construction of locks and dams extending from near mouth of Harpeth River (Lock A) to Big Eddy Shoals (Lock G); (second) of the improvement by dike construction and bank protection at the mouth of the river; (third) of the channel work necessary below Big Eddy Shoals; and (fourth) snagging and removal of surface obstructions below Nashville, at a total estimated cost of $1,964,500.

The total amount expended to June 30, 1893, including outstanding indebtedness and amount covered by contract, was $319,990.01. This expenditure has resulted in obtaining an increased depth at low water, thereby securing a lengthened season of navigation, combined with greater security in passage at some of the worst obstructions. The channel has been cleared from year to year of snags and other surface obstructions. At the mouth of river by contract the work of building dike and shore protection was nearly completed, and by hired labor the old spur dams were removed to increase the channel width, and the shore of Cumberland Island near the dams and the bank above foot of Island opposite the Kentucky mainland were protected by a revetment of piles, stone, and brush. This work is completed, and the bank is now thought to be permanently protected from erosion. As provided by act of July 13, 1892, the necessary sites were selected and approved by the Secretary of War for the proposed lock and dam (A) at or near the mouth of Harpeth River.

During the fiscal year, in July and August, 2,000.27 cubic yards of stone and 255 cords of brush were placed in position, completing the work under contract for dike construction at the mouth of river; contract was terminated on August 26. In September part of the upper dam was removed to facilitate the passage of steamboats.

The sites for Lock and Dam A, about 2½ miles below mouth of Harpeth River, were acquired by condemnation in the United States district court. Payment has been made for the lock site.

The amount expended during the fiscal year, including outstanding indebtedness, was, for general improvement, $734.61; at mouth of river, $5,796.06; lock and dam near mouth of Harpeth River, $3,168.39; total, $9,699.06.

July 1, 1893, balance unexpended	$31,919.85
June 30, 1894, amount expended during fiscal year	9,182.86
July 1, 1894, balance unexpended	22,736.99
July 1, 1894, outstanding liabilities	516.20
July 1, 1894, balance available	22,220.79
Amount appropriated by act of August 17, 1894	30,000.00
Amount available for fiscal year ending June 30, 1895	52,220.79
Amount (estimated) required for completion of existing project	1,894,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	500,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

b. Above Nashville.—From Nashville to head of Smith Shoals (337 miles).—The present project is based on an instrumental survey of this section made in 1883, and provides for the complete canalization of the river from Nashville to head of Smith Shoals, by the construction of 23 locks and dams below Burnside, and 7 locks and 2 dams at Smith Shoals, at an estimated cost of $7,500,000. Of this amount $775,000 has been appropriated.

The amount expended to June 30, 1893, including outstanding indebtedness, but not including the amount pledged under contracts, was $260,877.59; of the amount, $5,773.44 was expended at Smith Shoals. This expenditure has been applied in the examinations for sites of locks and abutment of Dams Nos. 1, 2 (old site), 3, and 4; in purchase of lock sites 1 and 2 (old site No. 2), and abutment of Dam No. 3; construction of lock-keeper's house, No. 1, and laying masonry of lock and abutment of Dam No. 1; in building cofferdam at old site of Lock 2, and payments for plant; in payments for channel work below Burksville, and for detailed surveys for sites for proposed locks of the Smith Shoals system of lockage.

During the present fiscal year 3,440.58 cubic yards of masonry were laid in walls of Lock 1, thus completing the contract of Henry F Holmes of October 17, 1890, for lock construction.

Authority was granted in March, 1893, to do the entire work by hired labor and purchase of materials in open market, it being recommended by the engineer officer then in charge as being more advantageous in time and money to the work than the contract system. Proposals were, however, solicited under this authority for supplying cut stone for Locks 3 and 4 by contract.

Under this authority, at Lock 1, by hired labor, 3,600 cubic yards of stone was placed behind land wall and 972 superficial yards of paving laid over the filling; also 2,596 cubic yards of stone placed as retaining wall above and below abutment of dam; began work of survey of approaches to lock and made soundings in lower approach.

Actual operations having established the fact that solid rock can not be found for the foundation of Lock No. 2 at the old site at anything like the depths specified in the contract for its construction, and that the character of the site at the depths so specified is altogether too insecure for the masonry of the lock, the contract of February 24, 1891, with Messrs. Rich & Holmes for building Lock No. 2 was terminated in accordance with its provisions.

Thorough examinations were made by series of test borings and soundings in order to determine upon the new sites for Lock 2, and in March the abandonment of the old sites for lock and dam and the selection of new sites were approved. The lock site, with necessary right of way, was purchased May 14, 1894. The site for abutment of dam has not yet been acquired, negotiations are pending, having in view a voluntary purchase from the owners, if practicable.

The sites for Locks and Dams 3, 4, 5, and 6 have been approved, and the sites for Locks 3 and 4, and abutment of Dam 4, acquired by condemnation proceedings in the Unied States district court; the abutment of Dam 3 was acquired by deed from the owners. The site for abutment of dam and seven-eighths of the site for Lock 5 have been purchased from the owners; the remainder of lock site will be conveyed to the United States on the perfecting of a slight defect in the chain of title. Sites for Lock and Dam 6 have not yet been acquired, the matter of title and price being undetermined. Examinations to determine sites for Lock and Dam 7 are progressing.

The land already acquired by the United States for canal purposes on the Cumberland River above Nashville aggregate 93.81 acres, and cost $9,900.59.

Bids were opened July 11, 1893, for supplying cut stone for the walls of Locks 3 and 4. The prices offered being deemed excessive, the bids were rejected, and authority granted to purchase the stone required in open market. Eight thousand six hundred and thirty-seven cubic yards of stone, consisting of sills, hollow quoins, pointed face, squared-face rubble, special stones, and backing, were bought for use in Lock 3; about one-third of this stone has been delivered, and the remainder will be, without unnecessary delay.

Under the authority of March 1, 1893, active operations have been carried on at Locks 2, 3, 4, and 5, as well as at Lock 1 as above stated. At Lock 2, new site, the lock site and right of way have been partly cleared, trench dredged for foundation, and 190 linear feet of cofferdam built, temporary buildings erected, and incline built for moving stone. At Locks 3 and 4, United States lands fenced, quarries opened, temporary buildings, trestles, tramways, and landing piers built; rights of way cleared and graded, clearing of sites and excavation in lock chambers begun, cofferdams completed, derricks, steam travelers, and hoisting and pumping machinery erected, laying concrete and brick in foundation of river wall, and filling culverts. The lock pit excavation of lock 3 is nearly completed, about eight-tenths of the brickwork of river wall, and one-half of filling culverts laid. Of Lock 4, about nine-tenths lock chamber and land wall excavation, and one-half of the brickwork of filling culverts, and all the brickwork and concrete for foundation of river wall completed. Stone cut for masonry, 1,352.75 cubic yards; backing quarried, 1,699 cubic yards; masonry laid in river wall, 351.6 cubic yards. At Lock 5, temporary buildings for quarters and storage of supplies erected, crib work for foundation of cofferdam (average height of 5 feet) has been placed in position from bank to bank and two-thirds filled.

Channel work.—An examination of the river was made from Burnside, Ky., to Hollemans Island, 183 miles, to ascertain condition as to surface obstructions. Surveys were also made of Wild Goose Shoals, Kettle Creek Shoals, and Lower Hollemans Island. At Wild Goose Shoals the dams were modified to force the current down the channel side. At Kettle Creek Shoals dam built 116 feet long, 16 feet wide, and 4½ feet high, and 28 overhanging trees cut down. Surface obstructions removed from Wild Goose Shoals to Carthage, Tenn., and dams repaired.

The steamer *Weitzel* was fitted out as a towboat with more powerful machinery, etc., at a cost of about $4,453.

A small steamboat, *John Phœnix*, was built for special use of survey parties and general work at low stages of the river, at a cost of about $2,200.

The steamer *Stephen H. Long* was temporarily transferred from the Tennessee River to the Cumberland River as a measure of economy and safety.

Six large stone barges, each 110 by 22 by 5 feet, were built for use in moving stone, etc., at a cost of $5,790.

Smith Shoals.—The examinations for sites of Locks and Dams, Nos. 1 to 5, inclusive, were completed and maps showing location of proposed sites prepared. The sites for Lock and Dam 6 have not yet been determined; survey for the site will be continued in July, 1894. Detailed maps of the proposed sites will be submitted for approval as soon as practicable. The amount expended during the fiscal year on account of allotments "at Smith Shoals" was $5,242.23.

The total amount expended during the fiscal year improving Cumberland River above Nashville, Tenn., was:

General river	$209,140.46
At Smith Shoals	5,242.23
Total expended	214,382.69

July 1, 1893, balance unexpended	$539,433.86
June 30, 1894, amount expended during fiscal year	214,382.69
July 1, 1894, balance unexpended	325,051.17
July 1, 1894, outstanding liabilities	50,767.02
July 1, 1894, balance available	274,284.15
Amount appropriated by act of August 17, 1894	200,000.00
Amount available for fiscal year ending June 30, 1895	474,284.15

Amount (estimated) required for completion of existing project	6,525,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	1,000,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

(See Appendix B B 6.)

8. *Caney Fork River, Tennessee.*—This stream, after a course of about 200 miles, wholly in the State of Tennessee, empties into the Cumberland River at Carthage, Tenn., about 116 miles above Nashville, Tenn. It is the largest and an important tributary of the Cumberland River.

An examination was made in 1879 as high up as Sligo Ford, about 72 miles, and in 1886 it was extended 20 miles farther to Frank Ferry, the head of navigation. The principal difficulties were found to be rock reefs, gravel and sand bars, a crooked, shallow channel, greatly impeded by surface obstructions.

The present project is to improve the river below Frank Ferry, 92 miles, by removing drift and other surface obstructions, and building the wing dams and training walls necessary to insure safe navigation for small steamboats and flatboats during the boating season, usually about five months in duration, from February to July.

The amount expended to June 30, 1893, including outstanding indebtedness, was $25,000, the total amount appropriated, which was used in removing surface obstructions, in reducing sand and gravel bars, and in repairing and building dams, and has resulted in a greatly improved channel from Frank Ferry to mouth of river.

Work in the channel was suspended August 15, 1891, the appropriation being then nearly exhausted. No appropriation was made for this river by the act of July 13, 1892.

July 1, 1893, balance unexpended	$20.00
July 1, 1894, balance unexpended	20.00
July 1, 1894, outstanding liabilities	20.00

Amount (estimated) required for completion of existing project	20,228.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	20,228.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

(See Appendix B B 7.)

IMPROVEMENT OF TENNESSEE RIVER BETWEEN CHATTANOOGA, TENNESSEE, AND FOOT OF BEE TREE SHOALS, ALABAMA.

This district was in the charge of Capt. George W. Goethals, Corps of Engineers; Division Engineer, Col. C. B. Comstock, Corps of Engineers.

1. *Tennessee River between Chattanooga, Tenn., and foot of Bee Tree*

Shoals, Alabama.—The original condition of the river from Chattanooga to Browns Ferry, as shown by examinations made in 1867, and subsequently, was unfavorable to navigation, the channel being obstructed by rock reefs, bars, bowlders, and projecting rocky points, permitting the passage of vessels from six to nine months annually. From Browns Ferry to Florence it was navigable only at unusually high-water stages, owing to the obstructions known as Big and Little Muscle shoals. Navigation between Florence and Riverton, Ala., was limited to about six months annually, owing to the obstructions known as Colbert and Bee Tree shoals.

The existing project of improvement is as follows:

(*a*) Removing obstructions by blasting and dredging at Ross Towhead, in "The Suck," and at Bridgeport and Guntersville, Ala.

(*b*) Building a canal 14.5 miles long, 70 to 120 feet wide, and 6 feet deep to permit navigation past the river obstructions known as Big Muscle Shoals; the canal to have 9 locks, each 60 feet wide by 300 feet long, and to cross Shoal Creek by means of an aqueduct 900 feet long and 60 feet wide. Constructing a canal 1½ miles long, to enable vessels to avoid the obstructions known as the Elk River Shoals; this canal to have 2 locks, one at each end.

(*c*) Blasting a channel through bed rock and building wing dams at Little Muscle Shoals; the project, as modified in 1890, contemplates the building of a canal along the north bank of the river 3 miles long, with 2 locks.

(*d*) Constructing a canal 8 miles long, 150 feet wide, and 7 feet deep past the Colbert and Bee Tree shoals obstructions, with 1 guard lock at the upper and 1 lock with 25-foot lift at the lower end; these locks to be 80 feet wide and 350 feet long.

The total amount expended to June 30, 1893, including outstanding liabilities, was $3,662,029.09 and resulted in the improvement of the river as follows:

Navigation through "The Suck" and the Pan was rendered easier by the removal of bowlders, detached rock, overhanging trees, and projecting rocky points. The channels through Tumbling Shoals, Poor Horse, and Broad Axe bars were straightened and deepened. At Ross Towhead, Guntersville, Bridgeport, and Beards Reef a large quantity of rock and gravel was removed, giving increased depth of channel and facilitating the discharge through the mountains below Chattanooga.

At Elk River and Big Muscle shoals the locks, gates, valves, and machinery for properly operating them were completed; the aqueduct and permanent stone dams finished, houses for lock-keepers and assistants constructed, a dredge and towboat for use of the canal built, and the canal opened to navigation the year round. The canal embankment was strengthened by placing broken stone along its entire length. The channels leading to Elk River Division were deepened and a number of drainage ditches dug. At Little Muscle Shoals the channel was deepened by blasting and wing drams built in accordance with the original project, giving increased depth.

At Colbert and Bee Tree shoals increased depth was obtained by excavating a channel and contracting the waterway by means of riprap dams; a survey of location for proposed lateral canal was completed and center line permanently marked by stone monuments. Arrangements were made for the purchase of 305 acres of land needed for canal purposes and bids opened for the construction of a 25-foot lift lock at lower end of canal.

The amount expended during the fiscal year, including outstanding liabilities, was $88,099.17, for which the following work was done:

Chattanooga, Tenn., to Decatur, Ala.—Under contract with W. A. Kirk, there were removed from the channel at Ross Towhead 5,322.8 cubic yards of rock and gravel and 400 feet of old wing dam. A straight channel has been thus made 150 feet wide, with a depth of 3 feet at low water. Some projecting rocky points are to be removed before the work is completed.

The channel at Bridgeport was enlarged to 120 feet width and 6 feet depth, and a channel formed above the railroad bridge 1,800 feet long, 40 feet wide, and 5 feet deep.

Decatur, Ala., to Florence, Ala.—The old wooden slide valves used in filling and emptying culverts were replaced by new iron balanced valves. Several tracts of United States ground were fenced.

Florence, Ala., to foot of Bee Tree Shoals.—A tract of $28\frac{21}{100}$ acres of land needed for canal purposes was purchased.

A contract was entered into with Tere A. Clark for the construction of a 25-foot lift lock at the lower end of the canal. Work under this contract has not been prosecuted as diligently as desired.

It may be summarized as follows:

	Cubic yards.
Earth removed from lock pit	46,450
Stone delivered on ground	4,997

Of this stone there were prepared for walls 631 cubic yards of fine-pointed stone, 174 cubic yards of rough-pointed stone, 18 cubic yards of rock-face stone, and about 2,336 cubic yards of backing ready for the wall.

Piles driven, including those used in dock and for supports of traveling crane, 685; linear feet of lock pit inclosed by sheeting, 1,063.

The money statement for this work includes that for Tennessee River, below Bee Tree Shoals, page 275, so as to embrace the entire reach of the river below Chattanooga, as follows:

Tennessee River below Chattanooga.

July 1, 1893, balance unexpended		$502,902.68
June 30, 1894, amount expended during fiscal year		81,205.59
July 1, 1894, balance unexpended		421,697.09
July 1, 1894, outstanding liabilities	$30,698.26	
July 1, 1894, amount covered by uncompleted contracts	289,988.08	
		320,686.34
July 1, 1894, balance available		101,010.75
Amount appropriated by act of August 17, 1894		400,000.00
Amount available for fiscal year ending June 30, 1895		501,010.75
Amount that can be profitably expended in fiscal year ending June 30, 1896 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.		2,105,000.00

(See Appendix C C 1.)

2. *Operating and care of Muscle Shoals Canal, Tennessee River.*—The canal has been in constant use since it was opened to navigation, November 10, 1890. The number of steamboats and barges, exclusive of small craft and Government boats engaged in the improvement of the Tennessee River and care of canal, that used the canal during the year, was 159, with a tonnage of 11,646. A dredge was kept constantly

employed removing sediment and in straightening and widening a part of the canal where two sharp curves interfered with the passage of vessels.

There was removed in this way 42,800 cubic yards of material; 1,275 drift logs were also removed during the year.

The total expenses during the year, including outstanding indebtedness, amounted to $63,772.63.

(See Appendix C C 2.)

IMPROVEMENT OF OHIO RIVER AND OF MUSKINGUM RIVER, OHIO.

This district was in the charge of Lieut. Col. Amos Stickney, Corps of Engineers, with Lieut. William C. Langfitt, Corps of Engineers, under his immediate orders since August 30, 1893; Division Engineer to November 22, 1893, Col. O. M. Poe, Corps of Engineers.

1. *Ohio River.*—The following is a summary of the work done during the fiscal year:

Davis Island Dam.—Quarters for the use of the employés have been erected on Davis Island.

Dam between Davis and Neville islands.—This dam was repaired where it had been slightly injured.

Dam between foot of Neville Island and Towhead.—This work was extended 583 feet to close a gap between the end of the dam and the towhead, caused by erosion.

Logstown.—Of the works recommended for this place by a Board of Engineers, the main dike has been completed, and the training dike at end of main dike nearly completed. The work has increased the depth on the bar by raising the water surface. The scouring effect on the channel is not known yet. A survey is in progress to determine what changes have taken place.

Clusters Islands.—Work under contract was begun on the dikes and dam projected for this place in August, and continued until December, 1893, and was resumed in April, 1894. Considerable work was done on Dike No. 4 and the dam, but the works are not as yet sufficiently far advanced to exert much beneficial effect. To aid the action of the proposed dikes, during May and June, 1894, 23,554 cubic yards of material was dredged from the bar, and materially improved the channel, but low water in the river prevented completion of the desired amount of dredging.

Rock bar at mouth of Licking River.—After completion of the steam drill scow for blasting purposes, a dredge and towboat were hired, and operations on the bar commenced in September. They were continued until November, when funds were exhausted; 4,215.5 cubic yards of material was removed. The method adopted has proved very economical.

Gauge near Cullums Ripple.—At the request of steamboat owners, pilots, and others a gauge was erected at this place to show passing boats the clear headway under the lowest bridge crossing the river at Cincinnati. It has proved of much value to the larger boats on the river passing under the bridges at that city.

Flint Island.—Navigation having been suspended for a time last season by the bar at this island, on which there was only 30 inches of water, a dredging plant was obtained and 1,200 cubic yards of material excavated, resulting in a good 5-foot channel being opened through the bar.

Chenaults Reach.—After finishing at Flint Island the plant was towed to this reach, where obstructions were reported, and removed from the channel 300 cubic yards of gravel and a large quantity of driftwood and logs. The channel was materially improved.

French Island.—Work under contract was begun on dikes and a dam proposed for this place in July, 1893, and continued until December, 1893, when it was suspended for the season. Work was resumed in June, 1894. One dike is approaching completion, and considerable work has been done on the other dike and the dam. To remove a portion of an old dike built in 1832, which was much in the way, and to supplement the action of the dikes, a dredging plant was hired in June, 1894, and at the close of the year had removed about 1,250 linear feet of the dike. An examination is now in progress to ascertain the condition of the channel and what changes have taken place.

Scuffletown.—Work under contract for two dikes proposed here was begun in August and continued until December, 1893, when it was suspended for the season. It was resumed in May, 1894, and is now in progress on both dikes.

Bar at mouth of Tradewater River.—Work under contract on dike proposed was commenced in July and continued until December, 1893, when it was suspended for the season. Pending investigation of the scouring action, which is known to be quite large, induced by the length of dike so far constructed, further extension of the dike is suspended. A survey of the locality is now in progress to ascertain the changes that have taken place.

Mound City, Ill.—Under contract for construction of two dikes proposed for this locality, work was commenced in September, 1893, and continued until December, 1893, when it was suspended for the season. At the close of the year work had not yet been resumed. The effect on the low-water channel can not be determined till the river falls to a low stage.

Operations of United States dredges.—After making the necessary repairs, work for the season was resumed by the United States dredges in June, 1893, and continued until November, when they were put in winter quarters. During this time they removed a total of 164,475.3 cubic yards of material, besides a large number of rocks, snags, piles, etc. The work materially improved many bad places and more especially the channel at Little Sewickley Creek Bar, Burlington Bar, Mill Creek Bar, Rising Sun Bar, and Gunpowder Bar. During the present season the dredges have worked at the Clusters, making a decided but not yet completed improvement of channel.

Surveys.—Special surveys were made at Mustapha Bar, Madison Harbor, French Island, and Eight Mile Bar.

The amount expended up to the close of the fiscal year ending June 30, 1893, was $5,188,734.62.

July 1, 1893, balance unexpended	$311,528.55	
Sale of property	650.00	
		$312,178.55
June 30, 1894, amount expended during fiscal year		124,585.08
July 1, 1894, balance unexpended		187,593.47
July 1, 1894, outstanding liabilities	$17,117.22	
July 1, 1894, amount covered by uncompleted contracts	35,706.85	
		52,824.07
July 1, 1894, balance available		134,769.40
Amount appropriated by act of August 17, 1894		250,000.00
Amount available for fiscal year ending June 30, 1895		384,769.40

Amount that can be profitably expended in fiscal year ending June 30, 1896 .... $1,000,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

(See Appendix D D 1.)

2. *Operating snag boat on Ohio River.*—The repairs to the snag boat were, from lack of funds, only those of the most urgent character. The boat worked from June 27 to November 13, 1893, removing in this time 810 snags, 70 wrecks, 59 piles, 45 cubic yards of stone, and one pile of mixed sawdust, slabs, and earth. Total distance traveled was 3,113½ miles. The officer in charge again earnestly recommends that the amount of money to be made applicable to this work each year be increased, as the amount, $25,000 per year, now provided by the permanent annual appropriation made by act of September 19, 1890, is not sufficient to keep the snag boat fully employed and in repair. An increase to $50,000 per year would, it is believed, enable this service to add greatly to the safety of navigation, and make it satisfactory to the river interests. The amount expended on this work to the close of the fiscal year ending June 30, 1893, was $60,578.13.

(See Appendix D D 2.)

3. *Operating and care of Davis Island Dam, Ohio River, near Pittsburg, Pa.*—This dam was built to test the adaptability of the system of movable dams to the peculiar condition of the Ohio River and to the special character of the commerce that navigates it. It was intended to be the first step in the radical improvement of the Ohio River designed to give a minimum depth of 6 feet at all times, except when ice was running. Incidentially this dam has been of great value to the city of Pittsburg, by securing an ample depth of water in its harbor throughout the low-water season. It has also been of immense benefit to the coal trade by enabling them to bring loaded boats out of the Monongahela river at any time. The natural harbor room of Pittsburg is very limited, and before the Davis Island Dam was built the great bulk of coal barges was held in the Monongahela. In short rises the amount of coal that could be shipped south was absolutely limited by the number of barges that could be locked through the lowest dam in the Monongahela during the passage of the rise. Under present conditions this limit no longer exists, and all coal can now be shipped for which towboats are available. During the fiscal year the lock and dam have been successfully operated without interference with navigation. The dam has been raised and lowered two times, and has been up 172 days during the fiscal year. The cost of operating and care of the dam during the year was $13,723.14.

(See Appendix D D 3.)

4. *Movable dam in Ohio River below mouth of Beaver River, Pennsylvania.*—Three hundred and fifty thousand dollars was appropriated for this work by acts of September 19, 1890, and July 13, 1892. Work of construction progressed satisfactorily during the season, and at its close about 80 per cent of the work of construction on the river wall, drift chute, gate recesses, and foundations of the lock had been completed. The protecting cribs of the coffer dam were somewhat injured in the spring freshets in 1893, but were subsequently repaired and strengthened.

Movable Dam No. 2, Ohio River.—The river and harbor act of July 13, 1892, provided for the use of so much of the money appropriated for the movable dam at Beaver as might be necessary for making a survey for the location of a dam, No. 2, and for obtaining title to the land. The survey has been made.

The amount expended on this work up to the close of the fiscal year ending June 30, 1893, was $97,149.55.

July 1, 1893, balance unexpended		$252,850.45
June 30, 1894, amount expended during fiscal year		173,706.01
July 1, 1894, balance unexpended		79,144.44
July 1, 1894, outstanding liabilities	$2,299.83	
July 1, 1894, amount covered by uncompleted contracts	32,145.28	
		34,445.11
July 1, 1894, balance available		44,699.33
Amount appropriated by act of August 17, 1894		75,000.00
Amount available for fiscal year ending June 30, 1895		119,699.33
Amount (estimated) required for completion of existing project		475,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896		200,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

(See Appendix D D 4.)

5. *Ice harbor at mouth of Muskingum River, Ohio.*—The object of this work was to furnish a place of refuge for Ohio River craft during ice floods. The project was the construction of a large lock through Dam No. 1, Muskingum River, to permit Ohio River vessels to pass into the pool. There has been expended thereon, up to the close of the fiscal year ending June 30, 1893, $327,940.39. The lock is now practically completed, with the exception of the machinery for operating the gates, and a small amount of masonry required to finish the lock walls. The lock can not be made available for the larger class of steamboats that usually navigate the Ohio and Muskingum rivers until the bridge of the Baltimore and Ohio Southwestern Railroad Company, just below it, has been changed. No steps have been taken by the railroad company to make the required alterations.

July 1, 1893, balance unexpended	$40.68
June 30, 1894, amount expended during fiscal year	10.00
July 1, 1894, balance unexpended	30.68
Amount appropriated by act of August 17, 1894	13,000.00
Amount available for fiscal year ending June 30, 1895	13,030.68

(See Appendix D D 5.)

6. *Muskingum River, Ohio.*—This report is limited to work carried on under the appropriation of $102,000 by act of August 11, 1888, for the construction of a lock at Taylorsville and the reconstruction of the lock at Zanesville, Ohio. The lock at Taylorsville is practically completed, with the exception of the machinery for operating the gates, but this lock can not be made available until a draw is placed in the county bridge just below it. The commissioners of Muskingum County, to which the bridge belongs, were ordered to change it, but thus far have not done so. Plans and estimates of cost of reconstruction of the lock at Zanesville are now under consideration.

The amount expended on this work up to the close of the fiscal year 1893 was $88,245.43.

July 1, 1893, balance unexpended	$13,754.57
July 1, 1894, balance unexpended	13,754.57
Transferred by act of August 17, 1894, to "Ice harbor, at mouth of Muskingum River"	13,000.00
Amount available for fiscal year ending June 30, 1895	754.57

(See Appendix D D 6.)

7. *Operating and care of locks and dams on Muskingum River, Ohio.*—As originally improved by the State of Ohio, 11 dams and 12 locks were built on the Muskingum River, furnishing continuous navigation for 91 miles from the Ohio River at Marietta to Dresden, where a connection was made with the Ohio Canal near its middle point, this canal extending from the Ohio River at Portsmouth to Lake Erie at Cleveland. The work cost the State of Ohio about $1,500,000. The lock and dam above Zanesville is now in a state of ruin, but the 75 miles of slack water between the Ohio River and Zanesville has always been maintained. On this piece of river there are 10 dams, 11 locks, and 5 lateral canals with a total length of 3⅝ miles. The repairs to locks and dams contemplated in the project for fiscal year have been completed, and necessary incidental work done. A number of spur dikes have been built during the year, to prevent further washing of the banks below the dams. The beneficial effect of these dikes is already very marked. Good navigation was maintained during the past season, and the river and structures are in good condition. Through navigation was suspended but a few days the past winter by ice forming in the canals, otherwise there was no stoppage. The bridges at Taylorsville and Marietta still constitute great obstructions to navigation on the Muskingum River, the first named preventing the use of the new lock at Taylorsville and the latter preventing the larger class of boats from entering the lock and ice harbor at Marietta, and causing much inconvenience and danger to smaller boats. The United States dredge and towboat have been usefully employed during the year in various operations for the maintenance of good channels.

The cost of operating and care of these works during the year was $53,320.73.

(See Appendix D D 7.)

8. *Removing sunken vessels or craft obstructing or endangering navigation.*—On November 30, 1893, during the unusual movement of the coal tows from Pittsburg down the Ohio River on the first fall rise, a number of collisions and accidents of various kinds occurred, causing wrecks of several entire tows and portions of others. Many of these wrecks remained in positions dangerous to navigation. Authority was obtained for their removal, and 11 wrecked coal boats and barges were removed in December, 1893, and January, 1894. On February 9, 1894, information having been received that some coal boats wrecked on the 6th, at Logstown, were dangerous to navigation, authority for their removal having been obtained, 3 entire coal boats and 1 fragment were removed.

(See Appendix D D 8.)

EXAMINATION FOR ICE HARBORS AT CINCINNATI, OHIO, MADE IN COMPLIANCE WITH SUNDRY CIVIL ACT OF MARCH 3, 1893.

An examination and survey at *mouth of Crawfish Creek, in the First ward, and mouth of Mill Creek, in the Twenty-first ward of Cincinnati, Ohio, as to availability of either or both of those localities for an ice harbor*, required by sundry civil act of March 3, 1893, was made by the local officer, Lieut. Col. Amos Stickney, Corps of Engineers, and his report thereon submitted under date of December 2, 1893.

Both of these localities have been heretofore reported upon as to their availability for ice harbors, and a survey of Crawfish Creek has once been made, and it is believed that sufficient information is available to indicate to Congress the advisability of these improvements being undertaken by the United States, and the probable cost of the work. The views of Col. Stickney are adverse to the proposed improvements, and in these views I concur.

The report was transmitted to Congress and printed in House Ex. Doc. No. 24, Fifty-third Congress, second session. (See also Appendix D D 9.)

IMPROVEMENT OF CHEAT, MONONGAHELA, AND ALLEGHENY RIVERS, WEST VIRGINIA AND PENNSYLVANIA.

This district was in the charge of Lieut. Col. Amos Stickney, Corps of Engineers, to December 14, 1893, and of Capt. R. L. Hoxie, Corps of Engineers, since that date, with Lieut. William C. Langfitt, Corps of Engineers, under the immediate orders of Col. Stickney, from August 30 to December 14, 1893; Division Engineer, to November 22, and since December 14, 1893, Col. O. M. Poe, Corps of Engineers.

1. *Monongahela River, West Virginia and Pennsylvania.*—The seven lower locks and dams on the Monongahela River belong to the Monongahela Navigation Company, and they create slack water from Pittsburg to Dunkard Creek, a distance of 88 miles. Locks and Dams Nos. 8 and 9, belonging to the United States, continue the slack water to Morgantown, a farther distance of 14 miles, the distance from Pittsburg to Morgantown being 102 miles. The originally adopted project for the improvement of this river was the construction of two locks and dams to continue slack water to Morgantown, W. Va. This improvement was completed in 1889.

Lock No. 10.—By the river and harbor act of July 13, 1892, the sum of $25,000 was appropriated for beginning work on Lock and Dam No. 10.

During the past fiscal year a careful examination has been made of the river in the vicinity of Morgantown, W. Va., for a distance of about 2½ miles measured along the river, for the purpose of fixing definitely upon a site for Lock and Dam No. 10. The interests of navigation appear to require that the site should be fixed at Falling Run, below Morgantown, and this location appears to be an advantageous one for the town. Local opposition having been encountered, the objections raised are now under consideration, with a view to reconciling, if possible, conflicting interests.

Lock and Dam No. 10 will be first in a series of six required for the completion of slack-water navigation to Fairmount. Projects have been presented from time to time for this improvement, but none have been definitely approved as yet. The appropriation of $25,000 in 1892 for the extension of the improvement of the Monongahela, is in line with the recommendations heretofore made, but this improvement will be of little value until completed. The cost of the entire work, including lock-keepers dwellings and the necessary outbuildings for each lock, will be about $1,320,000, an average of $220,000 for each lock and dam. It will be both economical and advantageous to the United States to make an appropriation of the entire amount required for the completion of the improvement, providing for such annual expenditure as may be thought advisable.

The amount expended on this work up to the close of the fiscal year ending June 30, 1893, is $438,301.51.

July 1, 1893, balance unexpended	$23,598.49
June 30, 1894, amount expended during fiscal year	2,134.41
July 1, 1894, balance unexpended	21,464.08
Amount appropriated by act of August 17, 1894	20,000.00
Amount available for fiscal year ending June 30, 1895	41,464.08

Amount that can be profitably expended in fiscal year ending June 30, 1896	$200,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix E E 1.)

2. *Operating and care of Locks and Dams Nos. 8 and 9, Monongahela River.*—During the past fiscal year these locks have been successfully operated without interruption to navigation except by high water on the night of February 4–5.

From Pools 8 and 9 obstructions have been removed aggregating 335 tons of logs, stumps, trees, etc. Dredging in the two pools amounted to 9,560 cubic yards. A new blacksmith shop was constructed at each lock to take the place of the old one. At Lock No. 8 repairs were made to some of the outbuildings, new valves were placed at the head of the turbine races, and repairs made to the operating machinery, to the coping of the lock walls, and the paving below the abutment. Bank protection below the lock was completed. The dam remains as repaired in 1891. The upper courses of sheeting and purlins should be relaid during the coming low-water season. At Lock No. 9 the Stoney valve continues to give trouble, and requires frequent repairs. Orders have been placed for material to reconstruct the lock gates. The concrete dam has been restored to its original height, giving two feet additional depth of water in Pool No. 9. Two new dwellings for lock keepers have been completed.

The cost of operating and care of these locks and dams during the last fiscal year was $28,684.82.

(See Appendix E E 2.)

3. *Purchase of Lock and Dam No. 7, Monongahela River.*—The river and harbor act of August 11, 1888, made provision for the acquisition by the United States, by purchase or condemnation, of this lock and dam from the Monongahela Navigation Company. Condemnation proceedings for this purpose were instituted. The case was heard in the circuit court of the United States for the western district of Pennsylvania in November, 1890, and the value of the work was fixed at $209,000. The navigation company took an appeal to the Supreme Court of the United States, where the case was argued at the October term, 1892. The judgment of the circuit court was reversed and case remanded, with instructions to grant a new trial.

July 1, 1893, balance unexpended	$161,835.45
June 30, 1894, amount expended during fiscal year	3.68
July 1, 1894, balance unexpended	161,831.77

(See Appendix E E 3.)

4. *Purchase of Lock and Dam No. 6, Monongahela River.*—An appropriation of $162,000 was made by river and harbor act of September 19, 1890, for acquisition of this structure from the Monongahela Navigation Company, after title to Lock and Dam No. 7 shall have been acquired by the United States. As the latter has not yet been obtained no steps have been taken toward negotiating for Lock and Dam No. 6.

July 1, 1893, balance unexpended	$167,000.00
July 1, 1894, balance unexpended	167,000.00

(See Appendix E E 4.)

5. *Cheat River, West Virginia.*—The channel of this river was originally filled with rock obstructions, which interfered with the free passage of drifting logs, thereby making the transportation of timber

from the head waters of this river to the markets along the Monongahela and Ohio rivers very hazardous. The river has been improved by the removal of rocks, and is now in fair condition between Rowlesburg and Green Island, a distance of 20¼ miles. As the appropriation for the improvement was exhausted, no further work was done during the past fiscal year.

The amount expended on this work up to the close of the fiscal year ending June 30, 1893, is $12,992.50.

July 1, 1893, balance unexpended	$7.50
June 30, 1894, amount expended during fiscal year	1.14
July 1, 1894, balance unexpended	6.36

(See Appendix E E 5.)

6. *Allegheny River, Pennsylvania.*—The original condition of the Allegheny River as to depth, width, and navigability can not be stated in definite figures, as there is no defined plane from which to measure, both the low-water line and the elevation of the river bed being variable. The approved project for the improvement of the river is the removal of obstructions from the channel and the construction of low dams to close double channels, and of dikes to confine the waterway where the river is too wide. Much benefit to navigation has resulted.

During the past fiscal year repairs have been made to the Corydon log chute, the abutments of the Hickory Dam, paving of the dike at Red Bank, and the dam at Nicholsons Island. Operations were commenced on the construction of a dam below Tionesta Creek, partially closing a back channel of the river. This was completed and sustained some damage during the winter, which has been repaired. The construction of a dam and dikes at Cowanshannock Ripple was commenced, the dam completed, the dikes partially completed. Obstructions were removed from the river channel aggregating 3,311 cubic yards of rock and 50 snags.

The amount available will be expended during the present working season in the completion of the improvement at Cowanshannock Ripple, and continuing the work of removing obstructions from the river channel.

July 1, 1893, balance unexpended	$23,057.46
June 30, 1894, amount expended during fiscal year	8,844.98
July 1, 1894, balance unexpended	14,212.48
Amount appropriated by act of August 17, 1894	12,500.00
Amount available for fiscal year ending June 30, 1895	26,712.48
Amount that can be profitably expended in fiscal year ending June 30, 1896 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	25,000.00

(See Appendix E E 6.)

7. *Dam at Herr Island, Allegheny River, near Pittsburg, Pa.*—The object of this dam is to begin a system of slack-water navigation and enlarge the harbor room at Pittsburg to the extent of the pool formed by the dam. The original project was for a fixed dam, but in compliance with the request of the authorities of Pittsburg and Allegheny City, the Secretary of War has ordered that the dam at Herr Island be made a movable one. Much delay was caused by suits brought by the riparian owners, but by a change of location, so that the lock was placed out from the bank, the rights of the riparian owners were preserved, and their opposition was withdrawn. The land necessary for

the lock and dam has been acquired and all legal questions as to damages to adjoining property settled. Observations of the current and water levels at site of dam have been taken and borings made for the purpose of determining the character of the river bed.

During the past fiscal year the cofferdam inclosing the site for the lock has been completed and the greater part of the necessary plant for the construction of the lock and dam has been purchased and received at the work. On the last day of the fiscal year the pumping out of the cofferdam would have been attempted but for defects in the pumping engine which developed under steam pressure. Temporary buildings have been completed for shops, store-houses, and office. A well 122 feet deep has been put down and equipped with a pump, for furnishing drinking water to the men, a matter of considerable importance in this locality. Plans for the lock and dam have been formulated in conformity with the conclusions of the Board appointed by Special Orders, No. 20, Headquarters Corps of Engineers, April 24, 1894, and estimates completed. The drawings are now in course of preparation.

With the approval of these plans, work may begin at once upon the construction of the lock.

The treacherous character of the river bottom and the contraction of the waterway by encroachments upon either side have made it a matter of some difficulty to maintain a cofferdam at this point during high water. Extensive repairs have been required, because of injuries sustained by the present cofferdam upon the occasion of two floods last winter. It is desirable that work should be vigorously pushed for this reason. The appropriations available will be expended in completing the greater part of the masonry of the lock.

July 1, 1893, balance unexpended	$107,765.64
June 30, 1894, amount expended during fiscal year	29,023.05
July 1, 1894, balance unexpended	78,742.59
July 1, 1894, outstanding liabilities	3,858.33
July 1, 1894, balance available	74,884.26
Amount appropriated by act of August 17, 1894	40,000.00
Amount available for fiscal year ending June 30, 1895	114,884.26
Amount (estimated) required for completion of existing project	414,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	300,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

(See Appendix E E 7.)

IMPROVEMENT OF FALLS OF OHIO RIVER, OF WABASH RIVER, INDIANA AND ILLINOIS, AND OF WHITE RIVER, INDIANA.

This district was in the charge of Lieut. Col. G. J. Lydecker, Corps of Engineers, to July 21, 1893; of Maj. Thomas H. Handbury, Corps of Engineers, from December 8, 1893, to May 12, 1894, and of Capt. James G. Warren, Corps of Engineers, since June 14, 1894, with Lieut. Hiram M. Chittenden, Corps of Engineers, under their immediate orders; and in the temporary charge of Lieut. Chittenden from July 21 to December 8, 1893, and from May 12 to June 14, 1894; Division Engineer since November 22, 1893, Col. O. M. Poe, Corps of Engineers.

1. *Falls of the Ohio River, at Louisville, Ky.*—The object of the improvements in progress is to afford increased facilities for passing

the Falls of the Ohio, via the Louisville and Portland Canal, by enlargements at its upper end and immediately above the locks, so as to form capacious basins, or harbors, at these points. The work at the head of the canal is also associated with the improvement of the Indiana chute, or the river channel over the falls, which becomes a line of descending travel when the rives rises to a height of about 10 feet on the upper canal gauge, and is the only route with the gauge reading 12.7 feet or more, when the canal locks can not be operated.

The canal enlargement at the head was inaugurated in 1883, the original project being afterward modified to conform with the recommendations made by a Board of Engineers in its report of January 28, 1890. Under the approved project the width of canal—now 90 feet—is to be made from 210 to 325 feet for a length of 2,400 feet, and east of this the enlarged canal will expand into a basin 800 feet wide by 2,200 feet long; the principal features of the work, as estimated, were 325,670 cubic yards of rock excavation and 270,000 cubic yards of earth excavation, the construction of about 5,200 linear feet of masonry wall and dams containing about 26,000 cubic yards, and the removal of 6,200 linear feet of old canal wall, dikes, and timber dams. The work done to June 30, 1894, comprised 174,245.03 cubic yards of rock, 212,019.31 cubic yards of earth excavation, and 13,678.83 cubic yards of masonry in new canal wall.

The enlargement above the locks was begun in 1887 with the object of constructing a basin 1,500 feet long and 250 feet wide, where boats can tie up and tows be properly formed before or after passing the locks without obstructing navigation through the canal. The work is completed, the results accomplished to June 30, 1894, being 22,744.60 cubic yards rock and 141,593 cubic yards earth excavation and 6,082.32 cubic yards masonry laid in new wall.

The total expenditures on these improvements to June 30, 1894, was $723,225.72, of which $6,274.55 was expended in the fiscal year ending on that date.

Special attention is invited to the fact that these improvements have been in progress, under small appropriations for the work to be done, since 1883, and no benefit whatever, except so far as relates to the basin at head of locks, has yet been secured to commerce, because of their unfinished state. Further, the work is of such a character that small appropriations must increase the ultimate cost in a peculiarly marked degree, because each season's operations can be inaugurated only after a very large expenditure for arrangements for the season's work, and the same expenditure must be repeated year after year while the work is in progress.

July 1, 1893, balance unexpended	$6,701.98
June 30, 1894, amount expended during fiscal year	6,274.55
July 1, 1894, balance unexpended	427.43
July 1, 1894, outstanding liabilities	161.01
July 1, 1894, balance available	266.42
Amount appropriated by act of August 17, 1894	60,000.00
Amount available for fiscal year ending June 30, 1895	60,266.42

Amount (estimated) required for completion of existing project	490,008.89
Amount that can be profitably expended in fiscal year ending June 30, 1896	300,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

(See Appendix F F 1.)

2. *Indiana Chute, Falls of the Ohio River.*—This is the main channel of the river over the Falls of the Ohio. Originally it was very crooked, with most irregular rock bottom, and swift, whirling currents. By removing the most prominent rocky projections it has been so improved that a large part of the river traffic can now descend by that route when the stage of water is up to, or above, 10 feet on the upper canal gauge. In 1890 a project for its more radical improvement was adopted, the object being to make it safely navigable when the river is not below a stage of 8 feet on the canal gauge. Commerce will be thereby relieved at such times from the delays incident to passing the falls via the Louisville and Portland canal and locks, an advantage which will be of the greatest importance to the heavy coal traffic, which alone amounts to about 1,700,000 tons annually. Nearly all this traffic would then follow the improved Indiana Chute, as the shipments of coal, when the river is at a lower stage than 8 feet, are exceedingly small.

Operations during the year were limited to repairs on cross dam at head of falls. The funds available after these repairs had been made were not sufficient to inaugurate other work.

The amount expended on the improvement of this chute to June 30, 1894, including outstanding liabilities, is $197,456.06.

July 1, 1893, balance unexpended	$12,145.68
June 30, 1894, amount expended during fiscal year	9,483.54
July 1, 1894, balance unexpended	2,662.14
July 1, 1894, outstanding liabilities	118.20
July 1, 1894, balance available	2,543.94
Amount appropriated by act of August 17, 1894	20,000.00
Amount available for fiscal year ending June 30, 1895	22,543.94
Amount (estimated) required for completion of existing project	37,250.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	37,250.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix F F 2.)

3. *Operating and care of Louisville and Portland Canal, Kentucky.*—The canal was open to commerce during the entire year without interruption, except for short intervals during the extreme low water in August, 1893, and high water in February, 1894, and a period of ten days from October 5 to October 15, 1893, when the canal was temporarily closed to make repairs. Traffic during the year comprised the passage of 5,853 boats and craft of all kinds with 1,398,776 tons of freight, 1,153,576½ tons being coal. The principal work done on the canal during the year, besides that relating to the passage of commerce, included dredging about 107,200 cubic yards from the canal, the erection of a pair of new guard gates at the old locks, the removal of 3 old bridges, the construction and erection of 2 new bridges and reerection of 1 of the old ones; revetment of slopes at new locks and just above; placing new pavement at new locks; completion of extension of city water supply to locks; removal of some rock from the channel and approach to lower lock; the erection of telephone connections between the branch office at head of canal and offices at locks; besides the usual repairs incident to the operation of the dredges, towboat, and scows, used in keeping the canal free from deposit, and machinery and plant used in shops and for operating the lock gates and keeping the whole plant in good condition.

The cost of operating and care of the canal during the year was $113,228.08.

(See Appendix F F 3.)

4. *Wabash River, Indiana and Illinois.*—The improvement of this river by the General Government was undertaken in 1872. Since 1881 separate appropriations have been made for the portions of the river below Vincennes, Ind., and above that point.

a. *Below Vincennes.*—The principal work during the past year had for its object the construction of the dam 1,100 feet long, at Grand Rapids, near Mount Carmel, Ill., which was begun July 8, and continued till November 30, 1893, when high water caused a suspension of work. The material used and work accomplished was as follows:

Excavation under foundation of dam	cubic yards..	3,600
Stone filling used in dam	do	5,420
Timber	feet, B. M..	954,840

The status of the dam at date of suspension was:

Linear feet completed to full height	400
Linear feet completed to within 2 feet of full height	700

The timber and nearly all of the stone filling necessary to complete the dam is on hand and will be put in place as soon as practicable after the necessary funds have become available.

The completion of the dam will reestablish navigation over the Grand Rapids, which has heretofore been an insuperable obstacle, except during periods of high water. But low-water navigation from that place to the mouth of the river will remain impossible until extensive repairs are made to the works heretofore built on that section, and which have now become almost useless because of damage by ice and freshet. Forty thousand dollars is required to complete the approaches to the new lock at Grand Rapids and to construct wing walls and revetments leading thereto and below.

The total expenditure for improving this section of the river from 1872 to June 30, 1894, including liabilities outstanding, was $664,770.40.

July 1, 1893, balance unexpended	$45,167.79
June 30, 1894, amount expended during fiscal year	44,858.19
July 1, 1894, balance unexpended	309.60
July 1, 1894, outstanding liabilities	80.00
July 1, 1894, balance available	229.60
Amount appropriated by act of August 17, 1894	15,000.00
Amount available for fiscal year ending June 30, 1895	15,229.60
Amount (estimated) required for completion of existing project	25,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	25,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

b. *Above Vincennes.*—Operations on this section of the river were limited to removing snags for a short season, from April 14 to May 30, 1894. These operations were confined to the reach of river between Terre Haute and Hutsonville. The total number of snags removed was 77, with an aggregate weight of 367.5 tons.

Funds available not being sufficient for further operations the snagboat *Osseo* was sent to White River.

Should any money become available the removal of snags from this portion of the river would be resumed.

The amount expended, including outstanding liabilities, on this section of the river to June 30, 1894, was $79,956.37.

July 1, 1893, balance unexpended	$2,262.34
June 30, 1894, amount expended during fiscal year	1,711.86
July 1, 1894, balance unexpended	550.48
July 1, 1894, outstanding liabilities	6.85
July 1, 1894, balance available	543.63
Amount appropriated by act of August 17, 1894	5,000.00
Amount available for fiscal year ending June 30, 1895	5,543.63
Amount (estimated) required for completion of existing project	10,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix F F 4.)

5. *White River, Indiana.*—The object of this improvement is to make the river navigable for the transportation of local products at all stages, by removing rocky reefs and gravel shoals, contracting the wider portions by dams or dikes, and removing snags. With sufficient money a navigable low-water channel with a depth of 2 feet might be realized. Operations during the past year were limited to the removal of snags, and it is proposed to continue such work during the summer and fall of 1894. When this has been done all the dams heretofore built on the river should be repaired and channels that had been made through bars and shoals should be redredged, in order to restore the river to the condition in which it was prior to the suspension of operations, as directed by Congress in the act of August 11, 1888.

The amount expended, including outstanding liabilities, on this river to June 30, 1894, was $109,517.68.

July 1, 1893, balance unexpended	$7,691.81
June 30, 1894, amount expended during fiscal year	4,709.49
July 1, 1894, balance unexpended	2,982.32
July 1, 1894, outstanding liabilities	1,069.50
July 1, 1894, balance available	1,912.82
Amount appropriated by act of August 17, 1894	5,000.00
Amount available for fiscal year ending June 30, 1895	6,912.82
Amount (estimated) required for completion of existing project	2,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	2,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix F F 5.)

IMPROVEMENT OF GREAT KANAWHA, ELK, AND GAULEY RIVERS, WEST VIRGINIA, AND OF NEW RIVER, VIRGINIA AND WEST VIRGINIA.

This district was in the charge of Col. William P. Craighill, Corps of Engineers.

1. *Great Kanawha River, West Virginia.*—This river flows through a fertile and picturesque region, filled with mineral wealth, especially coal and salt. It was by nature divided into a number of pools, some of considerable length and depth, separated by shoals of gravel and coarse sand, which were the principal obstructions to navigation in low water, there being often on them at such seasons but a few inches of

water. In some of the pools were found shallow places, also obstructing navigation. There were also snags and loose rocks in the channel. The navigation was almost suspended in summer.

The coal and salt were generally sent out on rises, which enabled the boats to pass safely over the obstructions that otherwise would stop their movements entirely. The use of the river for the movement of these valuable products was therefore unsatisfactory and intermittent. By the agency and superintendence of a board acting under the State, first of Virginia and then of West Virginia, considerable improvement in the river was from time to time effected, tolls being charged on the commerce for the payment of expenses.

The object of the improvement, begun several years ago by the United States, was to give a constant navigable depth of at least 6 feet throughout the whole length of the Kanawha to its mouth at the Ohio River; to be accomplished by large locks and dams.

Those already built have been about 300 by 50 feet above Charleston and about 340 by 55 below.

The peculiarity of most of the dams is that they can be lowered when the stage of the water in the river will suffice over the shoals. This gives them the name of "movable dams," and enables an open river to be had when the water is high enough.

Dams 3 and 2, above Paint Creek, are fixed, as the declivity of the river in that section is too great to permit the advantageous use of the movable system.

Up to June 30, 1893, the amount expended was $2,591,225.29. At that date the finished works were locks and dams 2, 3, 4, 5, and 6, and 7 and 8 nearly so. Contracts had also been made for 9, 10, and 11.

The following list of contracts indicates in a summary way the principal work in progress during the fiscal year:

Contract with The Fred. J. Meyers Manufacturing Company, dated June 8, 1892, for irons for the movable parts of dams Nos. 7 and 8, including the maneuvering winches, and some extra irons for dams Nos. 4, 5, and 6; completed September 20, 1893.

Contract with H. T. Morrison & Co., dated November 19, 1892, for ironwork for the gates of locks 7 and 8, to be completed July 20, 1893; time expired before completion of contract.

Contract with James M. Mays, dated March 31, 1893, to build two lock houses, one at the site of Lock No. 9 and one at the site of Lock No. 10, with outhouses at each; completed September 11, 1893.

Contract with L. Williams, dated April 17, 1893, for building one dump boat; completed August 15, 1893.

Contract with the West End Rolling Mill Company, Limited, and Chain Works, dated April 20, 1893, for chains and clevises for dams Nos. 7 and 8; completed September 15, 1893.

Contract with Zimmerman, Truax & Sheridan, dated May 23, 1893, for building Lock and Dam No. 9, to be completed December 31, 1896.

Contract with Thomas Munford, dated June 1, 1893, for building Lock and Dam No. 11, to be completed December 31, 1896.

Contract with Zimmerman, Truax & Sheridan, dated June 5, 1893, for building Lock and Dam No. 10, to be completed December 31, 1896.

Contract with Martin V. Smith for building a lock house with outhouses, at the site of Lock No. 11, dated October 4, 1893; completed March 12, 1894.

The amount expended in the year ending June 30, 1894, exclusive of outstanding liabilities, was $254,350.05.

Had funds been available, all the locks and dams needed for this improvement could have been begun at the same time and finished in three years with much economy to the United States and with manifest advantage in the use of the improved waterway. The development of commerce on this river has been very great since the improvement by the United States, although the project has as yet been only partially executed for want of money.

During the seasons of low water the value of the improvement is shown in a very marked manner, as free and sufficient navigation is then easily maintained over the improved part of the river, while navigation may be entirely suspended below the lowest dam and above the upper pool.

Locks and dams 7 and 8 were completed in the calendar year 1893, thus adding 18 miles to the improved portion of the river.

July 1, 1893, balance unexpended		$730,976.76
June 30, 1894, amount expended during fiscal year		254,350.05
July 1, 1894, balance unexpended		476,626.71
July 1, 1894, outstanding liabilities	$4,000.00	
July 1, 1894, amount covered by uncompleted contracts	880,602.52	
		884,602.52
Amount (estimated) required for completion of existing project		580,700.00
Amount that can be profitably expended in fiscal year ending June 30, 1896		580,700.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

(See Appendix G G 1.)

2. *Operating and care of locks and dams on Great Kanawha River, West Virginia.*—The amount expended during the fiscal year ending June 30, 1894, for this purpose was $28,745.60.

(See Appendix G G 2.)

3. *Elk River, West Virginia.*—The Elk is one of the chief tributaries of the Great Kanawha, emptying into it at Charleston. Its course is tortuous, but the country through which it flows is rich in minerals and well fitted for agriculture and grazing.

The average low-water width is about 200 feet, with narrows at the rapids of about 150 feet in width and occasional portions of about 300 feet in width. The pools vary in depth from 3 to 10 feet, and are separated by rapids over shoals of cobblestones and gravel, on which there has been at low seasons a depth of but a few inches of water. The average fall per mile in the river from Braxton down is about 2½ feet, but is not uniformly distributed, being greatest (about 4 feet per mile) in the central section and less (about 2 feet) in the upper and lower sections. Freshets of small height are of frequent occurrence, but rapidly pass off. The annual rise in the spring is about 10 or 12 feet. An extraordinary rise is sometimes had of 25 to 30 feet, but the duration is not great.

The approved project of improvement has been the removal of rocks, snags, overhanging trees, etc., and the making of narrow sluices through the rapids and shoals. The principal interests to be served are those of lumbering and rafting, but much country produce is also carried downstream in small boats, which return with merchandise, etc.

No work has been done in the river for want of money.

A serious obstruction to the navigation of this river at some stages consists of several old milldams. The attention of the proper authorities has been called to these in compliance with the law.

An application was made February 12, 1894, by the county court of Kanawha County, W. Va., to build a bridge across the river at Clendennin, W. Va. Some modifications were suggested by the local engineer. The necessary authority has been given by the Secretary of War.

July 1, 1893. balance unexpended	$84.70
June 30, 1894, amount expended during fiscal year	5.69
July 1, 1894, balance unexpended	79.01
Amount appropriated by act of August 17, 1894	2,000.00
Amount available for fiscal year ending June 30, 1895	2,079.01
Amount that can be profitably expended in fiscal year ending June 30, 1896 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	3,000.00

(See Appendix G G 3.)

4. Gauley River, West Virginia.—Gauley River takes its rise in Webster County, W. Va., its tributaries having their sources in Pocahontas and Greenbrier counties. It is about 115 miles in length, flowing through Nicholas and Fayette counties in a southwesterly direction, sometimes nearly west, and near its mouth almost due south; it is entirely in the State of West Virginia. Its head waters and those of its tributaries are covered with a virgin forest of the finest timber, with only clearings of a few acres here and there; and on the north side of the river, in Webster and Nicholas counties, some glades a few miles wide and in extent 20 or 25 miles, which give only a stunted growth, to break up this vast timber section.

For the first 12 miles from its mouth the Gauley falls only 4 feet per mile; in the next 26 miles its fall is nearly 34 feet per mile, in a gorge similar to that of New River, as seen from the Chesapeake and Ohio Railway between Kanawha Falls and Hinton, the hills on either side being several hundred feet high and almost perpendicular, and the stream full of bowlders of sandstone, some very large and so numerous as to justify the people in calling this section the "Roughs" of Gauley. From the head of the "Roughs" near Hominy Creek, 2 miles above Hughes Ferry, to the Forks, about 57 miles, the fall is estimated at 5 feet per mile. The levels from the mouth of Gauley River to the mouth of Meadow River, 29 miles, are taken from Ellet's report on the Great Kanawha River, West Virginia, made in 1858; the remainder are estimated. The levels on Meadow River were obtained from the same source.

Gauley River is 500 feet wide at its mouth, 350 feet wide at the mouth of Meadow River, 200 feet wide at mouth of Cranberry River, 150 feet wide at mouth of Williams River, and 75 feet wide at the Forks.

Operations for the improvement of the Gauley River were instituted after an examination made in 1878, in accordance with the provisions of the river and harbor act of August 5, 1886. It was then pointed out that a valuable improvement of the 12 miles of river from the mouth to the "Roughs" could be made at an expense of $10,000, and that a great advantage would follow the expenditure of $65,000 in the 26-mile reach called the "Roughs" in facilitating and cheapening the bringing to market of millions of feet of lumber of the most valuable and varied kinds.

The approved project has consisted in the removal of ledges and loose rocks and the making of channels through shoals of loose rock and bowlders from the mouth of the river to the "Roughs" to improve the navigation for boats and rafts, and in blasting down the very large bowlders in the "Roughs" to permit the more free passage of logs.

The amount expended to the close of the fiscal year ending June 30, 1893, was $8,702.12, with decided advantage to the navigation over the worst shoals below the "Roughs."

The amount expended in the fiscal year ending June 30, 1894, has been $102.46.

No work in 1894, for want of money.

July 1, 1893, balance unexpended	$117.88
June 30, 1894, amount expended during fiscal year	102.46
July 1, 1894, balance unexpended	15.42
Amount appropriated by act of August 17, 1894	3,000.00
Amount available for fiscal year ending June 30, 1895	3,015.42
Amount (estimated) required for completion of existing project	63,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	5,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix G G 4.)

5. *New River, Virginia and West Virginia.*—The last appropriation was that of August 5, 1886, of which a balance remains of $2,341.79.

In compliance with a recommendation of the local engineer, it was decided by the Secretary of War not to expend the existing balance at present.

There were no operations or expenditures in the year ending June 30, 1894.

The Chesapeake and Ohio Railroad has constructed a bridge over the unnavigable portion of this river not far above its junction with the Gauley.

July 1, 1893, balance unexpended	$2,341.79
July 1, 1894, balance unexpended	2,341.79

(See Appendix G G 5.)

IMPROVEMENT OF CERTAIN RIVERS IN KENTUCKY AND WEST VIRGINIA.

This district was in the charge of Maj. D. W. Lockwood, Corps of Engineers, having under his immediate orders Lieut. H. E. Waterman and Lieut. James J. Meyler, Corps of Engineers; Division Engineer, Col. O. M. Poe, Corps of Engineers.

1. *Tradewater River, Kentucky.*—This river was practically closed before the work of improvement commenced, by a rock bar near its mouth, and higher up by logs, snags, drift piles, leaning trees, and bars.

The present project, adopted in 1881, provides for clearing the river and its banks of obstructions, and opening up a channel 40 feet wide and 2½ feet deep during six months of the year, the improvement to extend 41 miles upstream from its mouth in the Ohio.

Up to June 30, 1893, $15,738.65 had been expended, resulting in securing a channel through the rock bar near the mouth of the river, and in removing obstructions in the channel and on the banks of the river for a distance of 41 miles, the distance covered by the present project.

July 1, 1893, balance unexpended	$761.35
July 1, 1894, balance unexpended	761.35
July 1, 1894, outstanding liabilities	24.00
July 1, 1894, balance available	737.35

(See Appendix H H 1.)

2. *Lock No. 2, Green River, at Rumsey, Ky.*—The deficiency act approved March 3, 1893, appropriated $65,000 for rebuilding this lock, which in 1892 was reported unsafe for navigation.

The project for this work, approved in 1893, calls for the construction of a new lock on the river side of the old lock, with certain changes of existing conditions to make them conform to location of lock.

The amount expended to June 30, 1893, was $1,645.39, and resulted in the commencement of the auxiliary dam and preparations for the general work.

The amount expended to June 30, 1894, was $34,295.14, and resulted in the completion of auxiliary dam, the construction of cofferdam surrounding part of lock site, excavation of rock inside coffer, and partial construction of head of lock. The work was much hindered and delayed by the failure of stone contractors to furnish stone.

July 1, 1893, balance unexpended	$63, 354. 61
June 30, 1894, amount expended during fiscal year	34, 295. 14
July 1, 1894, balance unexpended	29, 059. 47
Amount appropriated by act of August 17, 1894	105, 000. 00
Amount available for fiscal year ending June 30, 1895	134, 059. 47

(See Appendix H H 2.)

3. *Green River above mouth of Big Barren River, Kentucky.*—In pursuance of the provisions of act of September 19, 1890, an examination was made of this portion of Green River, and the report thereon, with project for the work proposed, was submitted to Congress as Appendix J J 15, Annual Report, Chief of Engineers, 1891.

The improvement proposed contemplated the construction of two locks and dams, so as to extend slack-water navigation to Mammoth Cave, at an estimated cost of $361,346.40.

The river and harbor act of July 13, 1892, appropriated $50,000 toward the construction of Lock No. 5, the project for which provides for the location and construction of a lock and dam at the head of slack-water navigation on the river.

The amount expended to June 30, 1893, was $596.02, in examining sites for lock and dam.

The amount expended during the fiscal year ending June 30, 1894, was $1,972.28, in continuing examination of sites, etc., and the preparation of a map of locality recommended for adoption.

July 1, 1893, balance unexpended	$49, 403. 98
July 30, 1894, amount expended during fiscal year	1, 972. 28
July 1, 1894, balance unexpended	47, 431. 70
Amount appropriated by act of August 17, 1894	25, 000. 00
Amount available for fiscal year ending June 30, 1895	72, 431. 70
Amount (estimated) required for completion of existing project	105, 673. 20
Amount that can be profitably expended in fiscal year ending June 30, 1896	105, 673. 20
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix H H 3.)

4. *Operating and care of locks and dams on Green and Barren rivers, Kentucky.*—When the United States acquired possession of these improvements, December 11, 1888, navigation of the system was broken at Lock No. 3, Green River, the river wall of that lock having fallen into the river, the lower end of the land wall at No. 1, Barren River,

was badly cracked and liable to fall at any time, and both walls of No. 2, Green River, were in a dangerous condition.

The channel of the river was much obstructed by snags and slides.

The operations up to June 30, 1893, resulted in the rebuilding of the old river wall at Lock No. 3; the taking down and reconstruction of the lower half of the river wall at No. 1, Barren; the rebuilding of dams Nos. 1, 3, and 4, Green River and No. 1, Barren; grading and paving behind the lock walls at the different locks, with the exception of No. 2, Green, and the building of seven lock-keepers' houses; also in the construction of a snag boat, dredge boat, and various barges and derrick boats required in the prosecution of the work.

During the fiscal year ending June 30, 1894, $48,088.06 was expended, and resulted in general repairs to locks and dams, grading and paving lock grounds, construction and extension of guide cribs at Lock No. 3, the removal of snags, and dredging lock entrances.

Navigation was temporarily suspended at Lock No. 2, Green River, during the construction of the new lock. At present craft of every kind are permitted to go through the lock, but no person is allowed on them during transit.

(See Appendix H H 4.)

5. *Rough River, Kentucky.*—This river was originally very much obstructed by overhanging trees on the banks, and by snags, logs, etc., in the bed of the river. The lower 8 miles of the stream is affected by backwater from the Rumsey Dam (No. 2), on Green River, but above this point the stream has but little depth at low water.

The project for the improvement, adopted in 1890, is to clear the river of obstructions, to wit, overhanging trees on the banks, and snags, logs, and stumps in the bed of the river, and to locate and construct a lock and dam near the site of the old ones to carry slack water to Hartford.

The amount of money expended to June 30, 1893, was $7,019.98, and resulted in a survey for the site of lock and preparing plans for the lock, dam, etc.; the removal of obstructions throughout the length of the stream from its mouth to Hartford, in the river, and the deadening of trees on the banks for the same distance; also in running a line of levels from Lock No. 2, Green River, to site of proposed lock.

The amount expended during the fiscal year ending June 30, 1894, was $470.30, in payment of outstanding liabilities in connection with work of the previous year.

July 1, 1893, balance unexpended	$32,980.02
June 30, 1894, amount expended during fiscal year	470.30
July 1, 1894, balance unexpended	32,509.72
Amount appropriated by act of August 17, 1894	22,500.00
Amount available for fiscal year ending June 30, 1895	55,009.72
Amount (estimated) required for completion of existing project	43,056.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	43,056.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

(See Appendix H H 5.)

6. *Kentucky River, Kentucky.*—The condition of the river when the United States assumed charge of its improvements was as follows: The five locks and dams, with their approaches, built by the State of Kentucky, were in a dilapidated condition, and the channel was much obstructed by snags and leaning trees.

The project for the improvement, adopted in 1879, called for the necessary repairs to the five locks and dams and the extension of slack-water navigation for a draft of 6 feet by the construction of additional locks and dams to Beattyville, a distance 261 miles from the mouth of the river.

Up to the close of the fiscal year ending June 30, 1893, $1,391,602.33 had been expended, resulting in the restoring of the locks and dams to a navigable condition, clearing the channel and banks of obstructions, and the partial completion of a new lock, known as No. 6 of the system, and in preliminary examinations for locating Lock No. 7.

The amount expended during the fiscal year ending June 30, 1894, was $39,519.45, and resulted in the completion of Lock and Dam No. 6, with guide cribs, grading and paving complete, the partial construction of two new lock-keepers' dwellings, and the building of a new towboat.

July 1, 1893, balance unexpended	$106, 397. 67
June 30, 1894, amount expended during fiscal year	39, 519. 45
July 1, 1894, balance unexpended	66, 878. 22
July 1, 1894, outstanding liabilities	1, 370. 66
July 1, 1894, balance available	65, 507. 56
Amount appropriated by act of August 17, 1894	125, 000. 00
Amount available for fiscal year ending June 30, 1895	190, 507. 56
Amount (estimated) required for completion of existing project	1, 399, 000. 00
Amount that can be profitably expended in fiscal year ending June 30, 1896	500, 000. 00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix H H 6.)

7. *Operating and care of locks and dams on Kentucky River, Kentucky.*—The first allotment for this work was for the fiscal year ending June 30, 1885, at which time only four locks could be operated. These required extensive repairs at the time, and the dams and approaches were in a more or less dilapidated condition.

The operations up to June 30, 1893, resulted in reopening Lock No. 5 to navigation and placing the other locks and dams in a serviceable condition, the building of guide walls, approaches, the construction of one double and seven single lock houses, and in grading, paving, and draining grounds about the locks. A new dredge boat of the Osgood pattern and two dump scows have been constructed, and general repairs made to locks, dams, etc., and, in addition, the river has been kept clear of snags. A stone abutment to Dam No. 2 has been constructed, and the lock entrances kept clear by dredging.

The amount expended during the fiscal year ending June 30, 1894, was $54,765.96, and resulted in the removal of rocks, snags, logs, etc., the construction of three new sets of lower gates, and the hanging of two of them in place.

(See Appendix H H 7.)

8. *Licking River, Kentucky, between Farmers and West Liberty.*—This stream was originally much obstructed by logs, snags, rocks, and leaning trees, as well as by fish dams constructed by private parties.

The project for the improvement was adopted in 1888, and provides for removing rocks, snags, and bowlders from the river bed.

The amount expended to June 30, 1893, was $6,000, and resulted in the removal from the bed of the river of a large number of rocks, snags, etc., that obstructed both rafting and low-water navigation.

Amount (estimated) required for completion of existing project	$11,680.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	5,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix H H 8.)

9. *Big Sandy River, West Virginia and Kentucky.*—When the United States commenced improving this stream it and its forks were much obstructed by rocks, bars, snags, and leaning trees. During low-water seasons navigation was practically suspended.

The original project for improvement was adopted in 1878, and provided for improving the push-boat and rafting facilities of the river and forks by removing obstructions, etc. This was modified in 1880 to secure slack-water navigation by the construction of a test lock and fixed dam, near Louisa, Ky.

At the close of the fiscal year ending June 30, 1891, the lock and the abutment had been completed and about 80 feet of the permanent dam built, but owing to protests against a fixed dam by the timber interests, a Board of Officers of the Corps of Engineers had been convened "to consider and report upon the subject of the dam," etc., and in its report dated November 10, 1891, the Board recommended the substitution of a needle dam for a fixed dam. This change of project was approved by the Chief of Engineers November 20, 1891.

The amount expended to June 30, 1893, was $281,852.54, and resulted in improving low-water navigation by the removal of rocks, stumps, snags, and logs from the channel, and leaning trees from the banks of the river, and in the construction of a lock 185 feet long, between hollow quoins, and 52 feet wide in the chamber; also in the completion of about 80 feet of the permanent dam under the project of 1880, and in cutting down the height of lock walls, the deepening of entrances to lock, the construction of shore cribs above and below lock, the protection of the Kentucky bank by riprap, and in the partial construction of a cofferdam to inclose the site of the pass and pier of the movable dam.

The amount expended during the fiscal year ending June 30, 1894, was $26,997.06, and resulted in the completion of cofferdam inclosing pass and pier, the completion of masonry, etc., of pass ready to receive trestles, the partial construction of pier, and partial removal of old abutment.

July 1, 1893, balance unexpended	$28,147.46
June 30, 1894, amount expended during fiscal year	26,997.06
July 1, 1894, balance unexpended	1,150.40
July 1, 1894, outstanding liabilities	156.02
July 1, 1894, balance available	994.38
Amount appropriated by act of August 17, 1894	40,000.00
Amount available for fiscal year ending June 30, 1895	40,994.38

Amount (estimated) required for completion of existing project	30,151.58
Amount that can be profitably expended in fiscal year ending June 30, 1896	30,151.58
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix H H 9.)

10. *Levisa Fork of Big Sandy River, Kentucky.*—This stream was originally much obstructed by rocks, snags, logs, and overhanging trees. Its improvement has been in progress since work on the Big Sandy was commenced under the project for the improvement of that stream.

The present project was adopted in 1890, and provides for the removal of snags, logs, stumps, rocks, etc., from the river, and overhanging trees on the banks.

The amount expended to June 30, 1893, was $22,376.10, and resulted in the material improvement of navigation by the removal of obstructions, giving increased facilities for push-boat navigation at low water, and rafting and light-draft steamboat navigation at moderate stages.

The amount expended during the fiscal year ending June 30, 1894, was $809.82, and resulted in the further removal of snags, rocks, logs, and stumps from the river bed.

July 1, 1893, balance unexpended	$873.90
June 30, 1894, amount expended during fiscal year	809.82
July 1, 1894, balance unexpended	64.08
Amount appropriated by act of August 17, 1894	2,500.00
Amount available for fiscal year ending June 30, 1895	2,561.08
Amount that can be profitably expended in fiscal year ending June 30, 1896 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	2,500.00

(See Appendix H H 10.)

11. *Tug Fork of Big Sandy River, West Virginia and Kentucky.*—This stream was originally much obstructed by rocks, snags, logs, and overhanging trees. Its improvement has been in progress since work on the Big Sandy was commenced on the project for the improvement of that stream.

The present project was adopted in 1890, and provides for the removal of snags, logs, stumps, rocks, etc., from the river, and overhanging trees from the banks.

The amount expended to June 30, 1893, was $22,416.99, and has resulted in the material improvement of navigation, giving increased facilities for push boats at low water, and rafting and light-draft steamboats at moderate stages.

The improvement has been carried to a point 100 miles above Louisa.

The amount expended during the fiscal year ending June 30, 1894, was $796.37, and resulted in the general improvement of the lower part of the stream.

The obstructions placed in the upper 22 miles of the improved portion of this stream by the Norfolk and Western Railroad and its contractors during the process of construction have been removed.

July 1, 1893, balance unexpended	$833.01
June 30, 1894, amount expended during fiscal year	796.37
July 1, 1894, balance unexpended	36.64
July 1, 1894, outstanding liabilities	.51
July 1, 1894, balance available	36.13
Amount appropriated by act of August 17, 1894	2,500.00
Amount available for fiscal year ending June 30, 1895	2,536.13
Amount that can be profitably expended in fiscal year ending June 30, 1896 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893	2,500.00

(See Appendix H H 11.)

12. *Guyandotte River, West Virginia.*—This stream was originally much obstructed by snags, logs, leaning trees, the remains of old dams, and milldams owned by private parties, which required removal.

The project for the improvement was adopted in 1878, and provided for the removal of existing obstructions, natural and artificial, so as to form a channel 30 feet wide, with a least depth of 18 inches, during five months of the year, and extending up the river a distance of 122 miles from the Ohio.

Up to the close of the fiscal year ending June 30, 1893, $18,445.64 had been expended, resulting in the partial improvement of the river for a distance of 119 miles, removing snags, logs, etc., from the channel, and cutting passageways through old dams.

During the fiscal year ending June 30, 1894, $26.08 was expended for mileage.

July 1, 1893, balance unexpended	$54.36
June 30, 1894, amount expended during fiscal year	26.08
July 1, 1894, balance unexpended	28.28
July 1, 1894, outstanding liabilities	.25
July 1, 1894, balance available	28.03
Amount appropriated by act of August 17, 1894	2,000.00
Amount available for fiscal year ending June 30, 1895	2,028.03
Amount that can be profitably expended in fiscal year ending June 30, 1896 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	2,000.00

(See Appendix H H 12.)

13. Little Kanawha River, West Virginia.—This river, at the time improvements were commenced by the United States, was much obstructed by logs, snags, leaning trees, etc., above that portion controlled by the Little Kanawha Navigation Company.

The original project, adopted in 1876, was for the removal of Beaver and Nailor Bend rocks, and for cleaning out snags and fallen trees. This was modified in 1880 by the adoption of an additional project for the construction of a lock and dam 2 miles above Burning Springs, W. Va.

Up to June 30, 1893, $210,911.83 had been expended, resulting in placing the upper part of the river in a fair rafting condition, and so that, during moderate stages, light-draft steamboats could run as far as Grantsville. The lock and dam 2 miles above Burning Springs have been completed, a lock house built, grounds graded and fenced, and slack-water navigation opened up for an additional distance of 9 miles.

During the fiscal year ending June 30, 1894, $238.29 was expended in repairs to the lock houses and for incidentals.

July 1, 1893, balance unexpended	$263.17
June 30, 1894, amount expended during fiscal year	238.29
July 1, 1894, balance unexpended	24.88
July 1, 1894, outstanding liabilities	1.60
July 1, 1894, balance available	23.28

(See Appendix H H 13.)

14. Operating and care of lock and dam on Little Kanawha River, West Virginia.—The lock was opened to navigation December 2, 1891, and has been operated continuously, with the exception of a short time in June, 1892, when it was closed temporarily for repairs.

During the last fiscal year there were times when, owing to the leaking of the dam of the navigation company next below, the lower miter sill was out of water.

The amount expended during the fiscal year ending June 30, 1894, was $2,445.32, applied to operating the lock and making general repairs to lock, dam, and lock walls.

(See Appendix H H 14.)

LAKE RIVERS AND HARBORS.

IMPROVEMENT OF RIVERS AND HARBORS ON LAKE SUPERIOR.

This district was in the charge of Maj. Clinton B. Sears, Corps of Engineers; Division Engineer, Col. O. M. Poe, Corps of Engineers.

1. Harbor at Grand Marais, Minn.—This small natural basin was not originally of sufficient depth, nor was it adequately sheltered either for commercial purposes or for use as a harbor of refuge; the approved project of 1879, therefore, proposed two breakwater piers each 350 feet long, from the east and west points of the bay, or one pier 700 feet long from the east point, and the dredging to a depth of at least 16 feet of an anchorage area of about 26 acres, at a total estimated cost of $139,669.40. Up to the close of the fiscal year ending June 30, 1894, there has been expended on this work $126,159.93; with this sum 350 feet of the east pier has been completed, and the 16-foot anchorage area increased to 23.5 acres. Of the above sum $9,689.75 was expended during the fiscal year ending June 30, 1894, in dredging, under contract with Messrs. Williams, Daugherty & Upham. There remains to be dredged, to complete the dredging project, 2.5 acres.

July 1, 1893, balance unexpended	$10,879.82
June 30, 1894, amount expended during fiscal year	9,689.75
July 1, 1894, balance unexpended	1,190.07
Amount appropriated by act of August 17, 1894	3,000.00
Amount available for fiscal year ending June 30, 1895	4,190.07
Amount (estimated) required for completion of existing project	9,319.40
Amount that can be profitably expended in fiscal year ending June 30, 1896	9,319.40
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix I I 1.)

2. Harbor at Agate Bay, Minnesota.—This is a shipping port for iron ore, and when the breakwater piers are built will form a harbor of refuge. It is 27 miles east of Duluth.

The project for the improvement of this harbor was adopted in 1887, and contemplates the erection of two piers projecting from the headlands of the bay and inclosing about 109 acres of water area. The eastern pier is to be 1,000 feet long and the western one 900 feet. Work upon the east pier was commenced in 1887, and at the close of work in November, 1891, 750 feet of it had been built.

The contract in force at the close of the last fiscal year, with Messrs. Powell & Mitchell, to build 200 feet of the west pier was successfully carried out, and an inspection made in June, 1894, shows both piers to be in good condition.

The amount expended to June 30, 1893, was $62,111.58; amount expended during fiscal year ending June 30, 1894, $27,110.66.

July 1, 1893, balance unexpended	$30,388.42
June 30, 1894, amount expended during fiscal year	27,110.66
July 1, 1894, balance unexpended	3,277.76
Amount appropriated by act of August 17, 1894	30,000.00
Amount available for fiscal year ending June 30, 1895	33,277.76

Amount (estimated) required for completion of existing project	$121,708.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	121,708.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

(See Appendix I I 2.)

3. *Harbor at Duluth, Minn.*—The original project for the improvement of the harbor, adopted in 1871, consisted of a breakwater in Lake Superior outside of Minnesota Point in continuation of one already commenced by the Northern Pacific Railroad Company. This breakwater was destroyed by a storm in 1872 and abandoned. In 1873 Congress provided for maintaining the canal through Minnesota Point, which had been constructed by the City of Duluth, and for dredging channels in Superior Bay to the Duluth docks.

Work under this project was continued until 1881, at which time the piers of the canal had been repaired and somewhat extended, a harbor basin dredged of moderate capacity, and a narrow channel dredged in Superior Bay from Duluth to deep water at Connor Point. The amount expended under this project was $270,651.81.

The present project was adopted in 1881 and modified in 1884 and 1888, the object being to preserve the piers bordering the canal, dredging an inner harbor to accomodate vessels drawing 16 feet of water, a channel parallel with the Park Point dock line 100 feet wide, a channel east of Rice Point 200 feet wide and 17 feet deep, and a channel along the north shore of St. Louis Bay 200 feet wide, 17 feet deep.

The river and harbor act of July 13, 1892, authorized the expenditure of $45,000 of the amount appropriated for this harbor in improving the channel of St. Louis River above Grassy Point.

The total amount expended on the harbor to June 30, 1894, is $767,981.53, of which $270,651.81 was expended prior to the adoption of the present project; the amount expended under the present project to the same date is $497,329.72. The work has resulted in increasing the dredged area of the harbor basin to about 104 acres, exclusive of private dredging, removing shoals from area previously dredged, giving nearly the whole dredged basin a minimum depth of 16 feet, maintaining the canal piers, making 16-foot channels east and west of Rice Point and on north shore of St. Louis Bay, and carrying the 16-foot depth to Ironton, 4½ miles up the St. Louis River. The dredging contract in force at the close of the last fiscal year was successfully carried out, and resulted in widening the channels east and west of Rice Point, in widening and deepening the channel along the north shore of St. Louis Bay, and in dredging out the shoal places between pools in the St. Louis River as far as to Ironton. A survey made on and through the ice last winter shows the channels to be in good condition and practically unimpaired.

The canal piers are in a poor condition and the entire work needs to be replaced with an improved and permanent structure. Eight hundred and twenty dollars and twelve cents were expended last fall in making repairs at the end of the north pier to protect it from ice and rafts.

The harbor basin and connecting channels will eventually require deepening to 22 feet. The channels recently commenced should be completed at an early date, both for the accommodation of commerce and as a matter of economy.

In compliance with a requirement of the river and harbor act approved July 13, 1892, an investigation was made of the question of ownership of the ground on which are located the canal and canal entrances and piers in Duluth Harbor, with the view of determining if the title of the

United States to the property is complete, and the report thereon, dated November 26, 1892, was submitted to the Secretary of War with the recommendations of the Chief of Engineers December 3, 1892; the papers were transmitted to Congress and printed as House Ex. Doc. No. 122, Fifty-second Congress, second session.

Plans for a tunnel under the canal, proposed to be constructed by the city of Duluth, were approved by the Secretary of War April 26, 1893.

July 1, 1893, balance unexpended	$90,844.41
June 30, 1894, amount expended during fiscal year	81,526.74
July 1, 1894, balance unexpended	9,317.67
Amount appropriated by act of August 17, 1894	75,000.00
Amount available for fiscal year ending June 30, 1895	84,317.67
Amount that can be profitably expended in fiscal year ending June 30, 1896 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	237,322.88

(See Appendix I I 3.)

4. *Harbor at Superior Bay and St. Louis Bay, Wisconsin.*—Originally the natural entry to Superior Bay was obstructed with shifting bars having at most but 9 feet depth of water over them. The citizens of Superior attempted to remedy this by constructing piers to confine the outflowing waters of the bay, and this work was taken up by the United States in 1867, and has successfully maintained since then a ruling depth of 16 feet between the piers.

The piers are 350 feet apart, and a good deal of dredging has been necessary to obtain the required depth between them and the channels leading to Connor Point and the Quebec dock and a new connecting channel in St. Louis Bay. The original project of 1867 has, therefore, been modified from time to time to meet the needs of the rapidly increasing capacity of the vessels visiting this port, the last modification being made by act of Congress approved August 5, 1886, which added improvement of channel in St. Louis Bay.

In carrying out the original project with modifications there had been expended to June 30, 1893, the sum of $222,303.86.

The contract in force at the close of the last fiscal year was completed by close of navigation in 1893, and resulted in widening and deepening the existing channels to a minimum depth of 16 feet, and in extending the 16-foot channel along the south side of St. Louis Bay clear through to a junction with the north channel at Grassy Point.

Repairs to the amount of $5,562.20 were made to the entry piers at their outer ends to protect them from ice and rafts. They will need further extensive repairs this season.

The land on which stands the southerly entrance pier does not belong to the United States and should be acquired by purchase or condemnation.

July 1, 1893, balance unexpended	$88,066.68
June 30, 1894, amount expended during fiscal year	73,036.06
July 1, 1894, balance unexpended	15,030.62
Amount appropriated by act of August 17, 1894	50,000.00
Amount available for fiscal year ending June 30, 1895	65,030.62
Amount that can be profitably expended in fiscal year ending June 30, 1896 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	156,736.00

(See Appendix I I 4.)

5. *Harbor at Ashland, Wis.*—Ashland Harbor is located at the head of Chequamegon Bay, and originally had no protection from the waves which rolled into the bay or from the waves generated within the bay itself by storms.

The approved project is for the construction of a pile, slab, and rock breakwater, 8,000 feet long, northeast of the town, and for dredging a channel in front of the wharves of the city to accommodate vessels drawing 16 feet of water. During the season of 1889 a portion of the breakwater, 4,650 feet in length, was completed, but a severe storm in November of the same year destroyed the outer 50 feet, and the slab filling settled in some places. During 1893, 1,680 feet was added to the breakwater, making its present length 7,363 feet. This was done under the contract in force at the close of the last fiscal year.

An unusually violent storm on May 18, 1894, did considerable damage to the older portion of the breakwater, estimated at $8,000. This is now being repaired, as far as the available balance left after the close of last season's work, some $3,000, will permit. At least $5,000 should be immediately available for the thorough repair of the work. Long delay will result in nearly doubling the ultimate cost of repair. The same storm made a breach through Chequamegon Point at a place not heretofore considered weak, and where no protection work had been placed. To repair this as it now exists will require $10,000. If left, it will probably widen considerably, though no great permanent deepening is apprehended.

No dredging has yet been done in Ashland Harbor.

The total amount expended under approved project to June 30, 1894, is $185,145.42.

The breakwater, though of insufficient length to give full protection to all the wharves of the city, has nevertheless had a marked influence in improving the tranquillity of the harbor.

July 1, 1893, balance unexpended	$49,417.66
June 30, 1894, amount expended during fiscal year	47,063.08
July 1, 1894, balance unexpended	2,354.58
July 1, 1894, outstanding liabilities	2,354.58
Amount appropriated by act of August 17, 1894	25,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	143,500.00

(See Appendix I I 5.)

6. *Harbor at Ontonagon, Mich.*—The entrance to Ontonagon River, which forms the harbor, had but 7 feet depth in 1867, at which time the project for securing 12 feet depth by building parallel piers on either side of the mouth, extending to the 18-foot curve of depth in Lake Superior, and dredging a channel between the piers was adopted.

The west pier has reached a length of 2,675 feet, and is very nearly out to the 18-foot curve of depth, as proposed. But this curve has advanced in the meantime, owing to the very considerable volume of sand carried into the lake by the river, and since it appears probable that the advance of the bar will keep pace with the extension of the piers, unless a very considerable extension is made at once, it does not appear that economic considerations would justify any further extension of the piers at present. The east pier is 2,315 feet in length.

For a time it seems that better results will be secured after the piers are put in repair by dredging across the bar after each spring freshet. A dredged channel through the bar and the remaining 150 feet of superstructure on the west pier were completed in 1891.

At the close of work in 1891 the channel was left with 16 feet of water in it, but the river freshets have partially filled this up since, and an examination made in May, 1894, showed still further shoaling, and work to the extent of some $6,500 is now in progress, dredging out between the piers and inside the harbor to make the channel available to vessels drawing 12 feet.

Several thousand dollars will have to be expended during the season in repairing the east pier. The contract in force at the close of the last fiscal year for the repairs to the piers was completed in August, 1893.

The amount expended during the fiscal year just closed, was $9,559.50.

The total cost of the improvement to June 30, 1894, was $317,439.72.

July 1, 1893, balance unexpended	$20, 219. 78
June 30, 1894, amount expended during fiscal year	9, 559. 50
July 1, 1894, balance unexpended	10, 660. 28
July 1, 1894, outstanding liabilities	4, 992. 53
July 1, 1894, balance available	5, 667. 75
Amount appropriated by act of August 17, 1894	7, 000. 00
Amount available for fiscal year ending June 30, 1895	12, 667. 75
Amount that can be profitably expended in fiscal year ending June 30, 1896 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	33, 000. 00

(See Appendix I I 6.)

7. Eagle Harbor, Michigan.—Previous to the improvement of Eagle Harbor the entrance was obstructed by a rocky reef, with 8½ feet of water over the shoalest part.

The project for the improvement of this harbor was adopted in 1866 and modified in 1868, 1874, and 1878. The plan, as finally carried out, consisted in blasting and dredging through the rocky ledge a channel 130 feet wide and 14 feet deep, marking it with two guiding cribs, one on each side of the channel, and the removal of a number of bowlders.

The amount expended to the close of the fiscal year ending June 30, 1894, was $95,238.08, and has resulted in carrying out the above project, the work having been completed in 1879 and meeting the present demands of commerce.

No appropriation is asked for this harbor, as the funds available will probably be sufficient to keep the work in good order for several years longer.

July 1, 1893, balance unexpended	$2, 286. 33
June 30, 1894, amount expended during fiscal year	524. 41
July 1, 1894, balance unexpended	1, 761. 92

(See Appendix I I 7.)

8. Waterway from Keweenaw Bay to Lake Superior, via Portage Lake and River, Michigan.—This work has heretofore been reported on as the Portage Lake and Lake Superior canals, across Keweenaw Point, Michigan.

In accordance with the provisions of the river and harbor act of September 19, 1890, the United States purchased and assumed the charge and care of these canals on August 3, 1891.

The improvements consist of entrance piers at the harbor entrances on Lake Superior and Keweenaw Bay, canals and canal revetments, dredged cuts and channel ways, lights, and buoys. There are no locks.

When the United States assumed charge the piers and revetments were, and are now, in a dilapidated condition; bars had formed at the harbor entrances, and many places in the channel ways had shoaled by deposition of material.

As the waterway is intended for the use of all vessels that navigate Lake Superior, and is actually used by a large proportion of them, it is necessary that the depth and width of the channels shall at least be equal to that of the St. Marys Falls Canal, which now limits the maximum draft and dimensions of the largest vessels which run to Lake Superior.

The last river and harbor act appropriated $50,000 for improvement, which has been expended in dredging the existing channels to a 16-foot depth and in repairing some of the worst portions of the canal revetments. An entire renewal of the piers and revetments is urgently needed.

The condition of the waterway has been greatly bettered since the United States acquired ownership, and no complaints from vessel men have been received this year. A least depth of 14 feet exists throughout the waterway. A legislative enactment imposing severe penalties for a violation of the established rules and regulations for the use of the canals is urgently needed.

July 1, 1893, balance unexpended	$38,165.52
June 30, 1894, amount expended during fiscal year	36,553.56
July 1, 1894, balance unexpended	1,611.96
July 1, 1894, outstanding liabilities	906.45
July 1, 1894, balance available	705.51
Amount appropriated by act of August 17, 1894	130,000.00
Amount available for fiscal year ending June 30, 1895	130,705.51
Amount (estimated) required for completion of existing project	1,115,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	800,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix I I 8.)

9. Operating and care of waterway from Keweenaw Bay to Lake Superior, via Portage Lake and River, Michigan.—The expenses of operating and care of this waterway for the fiscal year ending June 30, 1892, during which it was acquired by the United States, were paid by an appropriation of $10,000 made for the purpose by act of September 19, 1890.

During the fiscal year ending June 30, 1894, $11,647, from the permanent indefinite appropriation of July 5, 1884, was expended in maintaining, by dredging, a practicable 14-foot stage of water, in buoying and lighting the channels, in superintendence and general operation of the canals, and in guarding against encroachments on the legally established harbor lines.

(See Appendix I I 8.)

10. Harbor at Marquette, Mich.—Originally this harbor afforded no protection to vessels from easterly or northeasterly storms, and in 1866 a project was approved for the construction of a breakwater composed of cribs filled with rock and projecting from the shore into the bay a distance of 2,000 feet. This pier was finished practically as projected in

1875, but since its commencement extensive repairs have been made to the superstructure.

As the timber composing the superstructure has been in place longer than its durability justifies, it is essential that it be replaced by more durable material. A project for a concrete superstructure was approved in February, 1890. Its estimated cost is $232,936.71.

In the river and harbor act of August 11, 1888, provision was made for the extension of the breakwater. There was finished 60 feet of crib work and 180 feet of riprap foundation. The contract of 1890 extended the breakwater 240 feet, leaving 700 feet to be built to complete it.

The contract in force at the close of the last fiscal year to build 600 feet of this extension was successfuly carried out. The breakwater is now 2,900 feet in length.

After due advertisement a contract was made with Messrs. Powell & Mitchell, the lowest bidders, to build 100 feet of extension. This contract is now in course of execution and will bring the breakwater out to a length of 3,000 feet as contemplated in the project.

The breakwater in its present condition gives much protection to the harbor.

The amount expended during the fiscal year ending June 30, 1894, was $60,812.51.

The total cost of the work to June 30, 1894, is $463,266.64.

July 1, 1893, balance unexpended	$71,775.87
June 30, 1894, amount expended during fiscal year	60,812.51
July 1, 1894, balance unexpended	10,963.36
July 1, 1894, amount covered by uncompleted contracts	5,745.00
July 1, 1894, balance available	5,218.36
Amount appropriated by act of August 17, 1894	30,000.00
Amount available for fiscal year ending June 30, 1895	35,218.36
Amount (estimated) required for completion of existing project	227,936.71
Amount that can be profitably expended in fiscal year ending June 30, 1896	134,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

(See Appendix I I 9.)

11. Harbor of refuge at Grand Marais, Mich.—Originally the entrance to this harbor was obstructed by a bar having but about 6 feet depth of water upon it. The project for its improvement, adopted in 1881, has for its object a deep and safe channel into the harbor, making it a harbor of refuge. This object is to be attained by building parallel piers projecting into the lake and dredging out a channel between them, connecting the deep water of the lake with that of the harbor.

The proposed length of each pier was 1,800 feet. The west pier has now reached a length of 1,406 feet and the east pier 1,153 feet.

A channel 150 feet wide and 17 feet deep was dredged out between the piers in 1889, but it shoaled, and in 1891 it was again dredged, this time to a width of 175 feet and a least depth of over 17 feet, the outer ends of canal piers repaired, new shore ends and spurs put in, and the old shore ends remodeled. A partial survey in June, 1893, showed a shoaling to 14 feet. An examination made in June, 1894, shows that there is a least depth of 15.5 feet along the channel between the piers.

Allowing for one foot higher water this year than last, this shows a slight gain in depth, and may be due to the extension of the east pier last season, under the contract in force, June 30, 1893, with Powell & Mitchell, to build a 300-foot extension to the east pier.

As the piers have cut off the natural supply of sand for building up and maintaining the sand spit to the east of the piers, this spit has gradually been shaved off and eroded. It will probably be necessary to close the natural entry before long by an artificial work of some kind.

The total amount expended under approved project to June 30, 1893, was $227,574.93.

The amount expended during the year ending June 30, 1894, was $27,639.62.

July 1, 1893, balance unexpended	$33, 675. 07
June 30, 1894, amount expended during fiscal year	27, 639. 62
July 1, 1894, balance unexpended	6, 035. 45
Amount appropriated by act of August 17, 1894	20, 000. 00
Amount available for fiscal year ending June 30, 1895	26, 035. 45
Amount (estimated) required for completion of existing project	168, 750. 00
Amount that can be profitably expended in fiscal year ending June 30, 1896	100, 000. 00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

(See Appendix I I 10.)

IMPROVEMENT OF RIVERS AND HARBORS ON WESTERN SHORE OF LAKE MICHIGAN.

This district was in the charge of Maj. James F. Gregory, Corps of Engineers, with Lieut. Charles H. McKinstry, Corps of Engineers, under his immediate orders; Division Engineer, Col. O. M. Poe, Corps of Engineers.

1. *Manistique Harbor, Michigan.*—The natural channel of entrance to the mouth of the Manistique River was 7 feet deep. By private enterprise 3,000 feet of slab piers had been built at the mouth of the river and a channel dredged to 10 feet before any appropriation had been made by the Government.

The project for the improvement of the harbor was adopted in 1880, and consisted in dredging between the piers built by the Chicago Lumbering Company, increasing the depth of the channel to 12 feet for a width of 150 feet.

By the acts of 1880 and 1881 the sum of $6,000 was appropriated for this harbor in order to dredge a channel between the private piers of the above-mentioned dimensions. Dredging was done to the amount of 11,780 cubic yards, and work was then suspended in consequence of the refusal of the company controlling the harbor to rectify their pier lines when rebuilding the same.

Nothing has been done since work was suspended in 1881.

Soundings taken in May, 1892, show a navigable channel between the piers with a depth of 13 feet, but with a governing depth over the bar of about 11 feet.

The amount expended to June 30, 1893, was $3,500.60.

July 1, 1893, balance unexpended	$2, 499. 40
June 30, 1894, amount expended during fiscal year	71. 00
July 1, 1894, balance unexpended	2, 428. 40

(See Appendix J J 1.)

2. *Cedar River Harbor, Michigan.*—Previous to improvement the mouth of Cedar River was 175 feet wide and 8 to 10 feet deep, with a 3-foot bar in front.

Improvements had been made by private parties prior to the commencement of Government work.

The project of improvement was adopted in 1883, with a modification in the direction of the piers in 1884, the object being to afford an entrance channel of navigable width and 14 feet in depth.

Up to June 30, 1893, there had been expended $28,104.93, resulting in the construction of two pile piers 754 and 301 feet long, respectively, in continuation of the slab docks built by private enterprise, and a channel that in October, 1885, was 50 feet wide and 13 feet deep and 100 feet wide for a depth of 11 feet.

Soundings taken in April, 1894, showed a channel about 40 feet wide, and under favorable conditions vessels drawing 14 feet could enter the harbor.

Work was suspended in November, 1885, and has not been resumed by the United States since that date. It is reported that some dredging was done by private parties in 1891 and 1892.

July 1, 1893, balance unexpended	$1,895.07
June 30, 1894, amount expended during fiscal year	86.04
July 1, 1894, balance unexpended	1,809.03
Amount (estimated) required for completion of existing project	108,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix J J 2.)

3. Menominee Harbor, Michigan and Wisconsin.—Previous to the improvement of this harbor the depth of water at the mouth of the Menominee River was about 4 feet, and the river was navigable for boats of that draft for some 2 miles above its mouth.

The project for the improvement of the harbor was adopted in 1871 and modified in 1874, the object being to afford a channel of entrance of navigable width and not less than 14 feet depth.

The original and modified projects are completed, the object sought obtained, and the present demands of commerce fully met.

The amount expended up to June 30, 1893, was $211,929.68, resulting in the construction of two piers 400 feet apart, the north pier 1,854 feet long and the south pier 2,710 feet long, with a dredged channel 3,000 feet long, 200 feet wide and 16 feet deep from the 16-foot contour in Green Bay to the lower end of the channel of the Menominee River, of the same depth and width.

There were no operations during the fiscal year ending June 30, 1894.

The estimate for 1896 is $15,000, to make repairs urgently needed to the south pier.

July 1, 1893, balance unexpended	$132.32
July 1, 1894, balance unexpended	132.32
Amount appropriated by act of August 17, 1894	10,000.00
Amount available for fiscal year ending June 30, 1895	10,132.32
Amount that can be profitably expended in fiscal year ending June 30, 1896	15,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix J J 3.)

4. Menominee River, Michigan and Wisconsin.—The river and harbor act of September 19, 1890, appropriated $54,000 for "continuing the improvement up the river from termination of old work," and the original approved project was for dredging a channel 200 feet wide and 16 feet deep from Green Bay up the Menominee River as far as the funds available would allow, the object being to create a navigable channel 16 feet deep from Green Bay to N. Ludington Company's mill, a distance of about 2 miles. The project has been modified by reducing the upper 2,600 linear feet to a width of 100 feet.

The original navigable depth was about 4 feet.

When work was begun on the improvement in question the United States had increased the depth at the mouth of the river to 14 feet, and by private enterprise a tortuous channel had been dredged with a governing width of 50 feet and depth of 13 feet, extending up the river for a distance of 2 miles.

A large portion of the improvement made by private parties, however, was situated entirely outside of the limits of the present channel.

The amount expended to June 30, 1893, was $61,594.87.

The lower section, some 9,300 feet long, had then a width of 200 feet, except for a distance of 1,200 feet, where the average width was but 175 feet, and a general depth of 16 feet. The upper section, about 2,400 feet long, was practically completed for a distance of 1,000 feet; the governing depth in the remainder was about 4 feet.

During the fiscal year ending June 30, 1894, $12,710.89 was expended in drilling and blasting in hardpan, and in dredging 79,330 cubic yards of material. The lower section, 9,300 feet long, has now a channel 200 feet wide, except for a limited portion of its length, and a general depth of 16 feet. The upper section, 2,400 feet long, is practically completed for about 2,200 linear feet, and the governing depth in the remainder is about 8 feet.

The estimate for 1896 for maintenance of channel is $10,000.

July 1, 1893, balance unexpended	$12,958.63
Miscellaneous receipts credited to appropriation	26.53
	12,985.16
June 30, 1894, amount expended during fiscal year	12,710.89
July 1, 1894, balance unexpended	274.27
Amount appropriated by act of August 17, 1894	6,000.00
Amount available for fiscal year ending June 30, 1895	6,274.27
Amount (estimated) required for completion of existing project	4,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix J J 4.)

5. *Oconto Harbor, Wisconsin.*—In its natural condition the channel at the entrance to the Oconto River was obstructed by a bar with less than 2 feet of water over it. Previous to 1881, when the first appropriation was made for its improvement, the citizens, by the construction of a small amount of slab pier and by dredging, had increased the depth to 3½ feet.

The project of improvement adopted in 1882 proposes to secure an 8-foot channel from Green Bay to the city of Oconto, a distance of 2 miles, by dredging and constructing piers, at an estimated cost of $150,000.

The total amount expended up to June 30, 1893, was $67,910.67, resulting in the building of two piers, the north pier 1,603 feet and the south pier 2,151 feet in length, the latter being the full length contemplated by the approved project in the removal of 405,356 cubic yards of material and minor repairs. Owing to the narrowness of the dredged channel and the soft character of the material the spring freshets have a tendency to obliterate in places the dredging of previous years.

The governing depth of water at the harbor entrance was 7½ feet, and there was about 7 feet in the river as far up as Spies' mill, a distance of 9,000 feet.

In April, 1894, the depths were reduced to 7 feet and 6½ feet, respectively. Dredging in June, 1894, has increased the depth at entrance to 10 feet. Seventeen thousand and forty-five cubic yards of material was removed during the fiscal year.

During the fiscal year ending June 30, 1894, $1,534.85 was expended.

The estimate for year ending June 30, 1896, for maintenance of channel and repairs to piers is $10,000.

July 1, 1893, balance unexpended	$3,089.33
June 30, 1894, amount expended during fiscal year	1,534.85
July 1, 1894, balance unexpended	1,554.48
July 1, 1894, outstanding liabilities	16.18
July 1, 1894, balance available	1,538.30
Amount appropriated by act of August 17, 1894	3,000.00
Amount available for fiscal year ending June 30, 1895	4,538.30
Amount (estimated) required for completion of existing project	79,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix J J 5.)

6. *Pensaukee Harbor, Wisconsin.*—The original depth of water at the mouth of Pensaukee River was 2 feet, increased by private enterprise to from 7 to 9 feet for a width of 30 feet.

The project for the improvement of this harbor was adopted in 1883, and consisted of the construction of a single slab pier 2,500 feet long, in continuation of the pier built by private enterprise, and dredging a channel 10 feet deep and 100 feet wide on the south side of the pier.

The total amount expended up to June 30, 1893, was $13,935.64, resulting in the construction of 1,300 feet of the proposed extension of the pier, and the dredging of 5,698 cubic yards of material, making a channel 25 feet wide and 10 feet deep.

About 600 linear feet of the west end of the pier, damaged by fire in September, 1891, was repaired in October and November, 1891.

The last survey, made in May, 1890, showed the governing depth to be 2.8 feet.

There were no operations during the fiscal year ending June 30, 1894.

For maintenance of the piers an appropriation of $1,000 is recommended for year ending June 30, 1896.

July 1, 1893, balance unexpended	$1,064.36
June 30, 1894, amount expended during fiscal year	71.00
July 1, 1894, balance unexpended	993.36
Amount (estimated) required for completion of existing project	35,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	1,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix J J 6.)

7. *Green Bay Harbor, Wisconsin.*—Before the improvement of this harbor was begun the channel between the mouth of the Fox River

and the deep water in Green Bay was circuitous and narrow, with but 6 feet of water at its shoalest point.

The project of improvement was adopted in 1866, and subsequently modified so as to provide increased depth in 1872 and 1874, the object being to provide a dredged channel 200 feet wide, 14 feet deep, and 2 miles long in place of the natural channel, with a revetted cut across Grassy Island.

The project was further modified in 1892 to increase the depth of the present channel to 16 feet and extend it in a direct line through the bar off Sable Point, making its total length 16,500 feet.

The act of Congress of July 13, 1892, appropriating $25,000 for improving harbor at Green Bay, Wis., provided "that $5,000 of said sum may, in the discretion of the Secretary of War, be expended on the Fox River, below De Pere, Wisconsin."

To accomplish the object sought by the foregoing proviso, a project was adopted in 1892 for the improvement of the present tortuous channel by straightening it in places, and giving it a least width of 150 feet.

There was expended, up to the close of the fiscal year ending June 30, 1893, $301,069.97, resulting in a dredged channel 10,600 feet long, 200 feet wide, and 14 feet deep, and in the construction of 1,325 linear feet of revetment of the sides of a cut through Grassy Island. Work on the 16-foot channel was in progress, and about 3,000 linear feet completed for a width of 100 feet.

From the channel of the Fox River between De Pere and Green Bay, 41,575 cubic yards of material was removed, resulting in a channel way 14 feet deep and 145 feet wide, except for a small part of the distance.

During the fiscal year ending June 30, 1894, $20,449.07 was expended, resulting in the removal of 84,794.4 cubic yards of material from the 16-foot channel, and extending it to a total length of 10,200 feet. Repairs were made to the revetments, and a survey and map made extending from the city of Green Bay to the mouth of Fox River for the purpose of establishing dock lines.

The channel in Fox River below De Pere was completed to the full width of 150 feet.

The estimate for year ending June 30, 1896, to complete the 16-foot channel. is $46,915.

July 1, 1893, balance unexpended	$21,532.53
June 30, 1894, amount expended during fiscal year	20,449.07
July 1, 1894, balance unexpended	1,083.46
Amount appropriated by act of August 17, 1894	25,000.00
Amount available for fiscal year ending June 30, 1895	26,083.46
Amount (estimated) required for completion of existing project	46,915.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	46,915.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix J J 7.)

8. *Sturgeon Bay and Lake Michigan Ship Canal, Wisconsin.*—The Sturgeon Bay and Lake Michigan Ship Canal is a waterway cut through the neck of land separating Green Bay from Lake Michigan, and connects Lake Michigan with Sturgeon Bay, an arm of Green Bay, about 8 miles long, extending eastward into the peninsula and narrowing it at that point.

The canal was constructed by the Sturgeon Bay and Lake Michigan Ship Canal and Harbor Company, from 1872 to 1881, from the proceeds of sale of 200,000 acres of public lands granted to the State of Wisconsin for the purpose by acts of Congress of April 10, 1866, and March 1, 1872. A full history and description of the work is given in reports contained in the Annual Report, Chief of Engineers, 1887, pages 2017 to 2037, and in House Ex. Doc. No. 106, Forty-ninth Congress, second session.

The canal affords a considerable shortening of distance for many vessels over the natural outlet of Green Bay into Lake Michigan about 50 miles to the north, admits the avoidance of the dangers of the natural route, and makes Sturgeon Bay available and accessible as a harbor of refuge for vessels on Lake Michigan.

The river and harbor act approved July 13, 1892, appropriated $81,833 for making the canal free to commerce. The conditions of the act being fulfilled, the property was purchased from the company and the money appropriated therefor paid in April, 1893, and the United States assumed possession of the canal on April 25, 1893.

The canal is an open cut, without locks or gates, 7,200 feet long; it is 100 feet wide at the water surface, about 65 feet wide at bottom, and 13 feet deep. Harbor works at the Lake Michigan entrance have been constructed by the United States. Dredging has been done in continuation of the channel 6,100 feet into Sturgeon Bay. The banks are only partly revetted; 8,437 feet of the existing revetments requires extensive repairs, and 6,000 feet remains to be constructed.

The foregoing is a description of the work and its condition at the close of the fiscal year ending June 30, 1893, and the amount expended by the United States was $81,833.

During the fiscal year ending June 30, 1894, there being no funds available for enlargement or improvement of the canal, there were no expenditures other than for operating and care provided for by indefinite appropriation, section 4 of the river and harbor act of July 5, 1884.

The existing project submitted in 1893 provides for extending the revetments to the 14-foot contour in Sturgeon Bay and widening this portion of the canal to 160 feet, at an estimated cost of $98,450. An appropriation of $20,000 was made for this work by the river and harbor act of August 17, 1894, and the balance of the estimate ($78,450) can be profitably expended during fiscal year ending June 30, 1896.

Amount appropriated by act of August 17, 1894	$20,000.00
Amount (estimated) required for completion of existing project	78,450.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	78,450.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix J J 8.)

9. *Operating and care of Sturgeon Bay and Lake Michigan Ship Canal, Wisconsin.*—Under the continuous appropriation for operating and care of canals and other works of navigation, 37,744 cubic yards of material were removed for maintenance of the canal, and necessary repairs made to the revetments, etc., pertaining to the canal, during year ending June 30, 1894.

The amount expended under the indefinite appropriation provided by section 4 of the river and harbor act of July 5, 1884, during the fiscal year was $14,579.11. The detailed statement appended to the report of the local engineer officer shows the items of expenditure.

For the year ending June 30, 1895, it is proposed to maintain existing works by such dredging and repairs as may be necessary.

(See Appendix J J 9.)

10. Harbor of refuge at eastern entrance of Sturgeon Bay and Lake Michigan Ship Canal, Wisconsin.—Before the construction of this harbor was undertaken the Lake Michigan entrance to the Sturgeon Bay and Lake Michigan Ship Canal was entirely unprotected from storms ranging from northeast and southwest.

The project of constructing a harbor of refuge at this point was adopted in 1873 and modified in 1879 and 1880. The modified project, as carried out, consists of two piers, each 1,344 feet long, 850 feet apart at the shore line, protecting the lake entrance of the canal, and converging so as to make the harbor entrance 335 feet wide, inclosing an area of about 10 acres, with a depth of at least 16 feet.

The total expenditure at this harbor up to June 30, 1893, was $169,617.96, resulting in the completion of the piers as projected, and in a dredged channel 16 feet deep and 120 feet wide from the 16-foot contour in Lake Michigan to the canal entrance. The channel had been reduced at that date by shoaling to a depth of 14.3 feet.

During the fiscal year ending June 30, 1894, $1,803.64 was expended for repairs to the piers, guide piling, and dredging plant. The channel had become reduced in depth to 13 feet; it was restored to 16 feet for a width of 120 feet by the removal of 14,260 cubic yards of material.

The estimate for the year ending June 30, 1896, is $7,000 for maintenance of channel and piers.

July 1, 1893, balance unexpended	$3,561.54
June 30, 1894, amount expended during fiscal year	1,803.64
July 1, 1894, balance unexpended	1,760.90
Amount appropriated by act of August 17, 1894	5,000.00
Amount available for fiscal year ending June 30, 1895	6,760.90
Amount that can be profitably expended in fiscal year ending June 30, 1896	7,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix J J 10.)

11. Ahnapee Harbor, Wisconsin.—Previous to the improvement of this harbor the depth of water at the mouth of the Ahnapee River was only about 2 feet.

The project of improvement, adopted in 1875 and modified in 1884, provided for the formation of a small artificial harbor, connected with the lake by a channel 100 feet wide and 12 feet deep, formed by the construction of two piers extending to the 18-foot contour, with a 200-foot entrance between the pier heads.

The total amount expended up to June 30, 1893, was $166,908.10, resulting in the construction of two piers, the north one 1,102 feet long and the south one 1,125 feet; in the removal of 30,528 cubic yards of rock and 137,893 cubic yards of sand and gravel, and in placing a double row of sheet piling along 352 feet of the north pier and 620 feet of the south pier. The rock was used for refilling and riprapping the piers.

The depth of water at the entrance was 16 feet, and 11 feet at the shore ends of the piers.

Of the area from which rock had been excavated, one-third had the required depth of 12 feet, the remaining two-thirds an average depth of about 9 feet.

During the fiscal year ending June 30, 1894, $4,077.73 was expended. The main and detached piers were connected by the construction of 225.6 linear feet of guide piling, and minor repairs were made to the north pier.

Soundings taken in April, 1894, showed a depth of water at the entrance of from 15 to 16 feet, and at the shore ends of the harbor piers about 10½ feet.

The estimate for year ending June 30, 1896, to complete the pier extension, rock removal, and dredging, and to renew decayed superstructure, is $15,000.

July 1, 1893, balance unexpended	$6,311.90
June 30, 1894, amount expended during fiscal year	4,077.73
July 1, 1894, balance unexpended	2,234.17
Amount appropriated by act of August 17, 1894	5,000.00
Amount available for fiscal year ending June 30, 1895	7,234.17
Amount (estimated) required for completion of existing project	15,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	15,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix J J 11.)

12. *Kewaunee Harbor, Wisconsin.*—The natural channel to this harbor was through the Kewaunee River. The river mouth was not more than 20 feet wide, with a depth of about 2 feet at its shoalest point, and was obstructed by submerged bowlders.

The project of improvement was adopted in 1881. Its design was to cut a channel 14 feet deep through a neck of land between the river and the lake at a point about 2,000 feet south of the river mouth, and to continue this channel to deep water in the lake by the construction of two parallel piers, 200 feet apart, extending from each side of the cut lakeward to the 18-foot contour.

The total amount expended on this harbor up to the close of the fiscal year ending June 30, 1893, was $81,064.40, in addition to which the local harbor commissioners had expended $8,042.72. At that time 1,250 feet of the north pier and 1,175 feet of the south pier had been constructed, and there was a governing depth in the entrance channel of about 13 feet, with least width of 50 feet.

During the fiscal year ending June 30, 1894, $23,374.60 was expended. Each pier was extended 250 feet, piers repaired, and 22,425 cubic yards of material removed by dredging. The channel formed was 120 feet wide and 14 feet deep.

Soundings taken in April, 1894, showed a channel of navigable width with a depth of 13.6 feet.

For the year ending June 30, 1896, the estimate is $66,943.28, to be expended chiefly for pier extension.

July 1, 1893, balance unexpended	$23,949.60
June 30, 1894, amount expended during fiscal year	23,374.60
July 1, 1894, balance unexpended	575.00
Amount appropriated by act of August 17, 1894	20,000.00
Amount available for fiscal year ending June 30, 1895	20,575.00
Amount (estimated) required for completion of existing project	66,943.28
Amount that can be profitably expended in fiscal year ending June 30, 1896	66,943.28
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix J J 12.)

13. Two Rivers Harbor, Wisconsin.—Previous to the improvement of this harbor the natural channel was obstructed by a bar covered by but 2 or 3 feet of water.

The project of improvement adopted in 1870 provided for the formation of a channel of navigable width and not less than 12 feet deep, to be accomplished by the construction of two piers, extending from the mouth of Two Rivers lakeward to the 18-foot contour in Lake Michigan, and dredging a channel between them.

The amount expended up to the close of the fiscal year ending June 30, 1893, was $204,487.71, which was expended in the construction of two parallel piers, the north and south pier being 1,810 and 1,710 feet long respectively, in dredging, and in repairs to the piers. Dredging to restore the channel 120 feet wide and 12 feet deep was in progress, and over one-half of the desired width obtained.

During the fiscal year ending June 30, 1894, $1,461.36 was expended. Dredging was continued to July 31, 1893. Eleven thousand seven hundred and sixty-five cubic yards of material was removed, and the channel completed to a width of 120 feet. Minor repairs were also made to the piers, sheet piling, and sand fences.

Soundings taken in April, 1894, indicated considerable shoaling in the channel, it being but 11 feet deep and 60 feet wide.

Estimate for year ending June 30, 1894, for maintenance and repairs is $18,800.

July 1, 1893, balance unexpended	$2,012.29
June 30, 1894, amount expended during fiscal year	1,461.36
July 1, 1894, balance unexpended	550.93
Amount appropriated by act of August 17, 1894	3,000.00
Amount available for fiscal year ending June 30, 1895	3,550.93
Amount (estimated) required for completion of existing project	56,088.80
Amount that can be profitably expended in fiscal year ending June 30, 1896	18,800.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix J J 13.)

14. Manitowoc Harbor, Wisconsin.—Previous to the improvement of this harbor but 3 feet of water existed at the shoalest point over the bar at the mouth of the Manitowoc River.

The original project, adopted in 1852, provided for the construction of two parallel piers, 220 feet apart, extending from the mouth of the river to the 12-foot contour in Lake Michigan. In 1881 this was modified so as to secure a deeper channel by extending the piers to a depth of 18½ feet and dredging to not less than 14 feet.

A supplementary project, for the construction of an exterior breakwater 400 feet long, to cost $40,000, and afford protection from northeast storms, was submitted in 1891, and an appropriation made in 1892 to begin the work, but it was not considered advisable to commence it until sufficient funds were provided to complete it.

The total amount expended up to June 30, 1893, was $309,388.57, resulting in the construction of two piers, the north one 1,970 feet and the south one 1,900 feet long, 228 feet apart at the shore line and 250 feet at the outer ends, renewal of superstructure of piers, and in the removal of 201,064 cubic yards of material by dredging.

The channel had a navigable depth of 14.7 feet.

During the fiscal year ending June 30, 1894, $3,788.10 was expended in rebuilding 592 linear feet of the south pier above the water line and in minor repairs to piers and dredging plant.

April 1, 1894, soundings showed the depth at entrance to be from 16½ to 17 feet, but the governing depth between the piers was reduced to 14 feet.

In addition to funds appropriated in 1892 for construction of breakwater, and now available, the estimated amount required for year ending June 30, 1896, to complete and maintain the works is $5,000.

July 1, 1893, balance unexpended	$26,651.93
June 30, 1894, amount expended during fiscal year	3,788.10
July 1, 1894, balance unexpended	22,863.83
Amount appropriated by act of August 17, 1894	20,000.00
Amount available for fiscal year ending June 30, 1895	42,863.83
Amount (estimated) required for completion of existing project	5,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	5,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix J J 14.)

15. Sheboygan Harbor, Wisconsin.—Previous to the improvement of this harbor the natural channel had a depth not exceeding 4 feet on the bar at the entrance of the river.

The original project for the improvement of this harbor was adopted in 1852, and had for its object the formation of a 12-foot channel entrance to the mouth of the Sheboygan River. This was modified in 1873 so as to secure a deeper channel by further pier extension and dredging. Both projects were completed within their estimated cost, and a channel was formed 100 feet wide, with a depth of 15 to 16 feet between the piers. This was further modified in 1881, the present project having for its object to deepen the channel still further, by extending the piers to the 20-foot contour in the lake and dredging to a depth of 18 feet between their outer ends, the depth decreasing to 14 feet at the shore line.

The total expenditure up to June 30, 1893, amounted to $325,077.39, resulting in the construction of a north and a south pier 2,270 and 2,387 feet long, respectively, and the removal by dredging of 289,038 cubic yards of material. The channel had a depth of 16 feet.

During the fiscal year ending June 30, 1894, $15,861.12 was expended. Each pier was extended 100 linear feet and minor repairs were made to the piers.

The channel decreased in depth about 0.4 feet, the governing depth March 28, 1894, being 15.6 feet.

The north pier is now 2,370 feet long and the south pier 2,487 feet long.

The estimate for year ending June 30, 1896, for completion of existing project, including $64,900 for maintenance and repairs, is $81,900.

July 1, 1893, balance unexpended	$18,371.52
June 30, 1894, amount expended during fiscal year	15,861.12
July 1, 1894, balance unexpended	2,510.40
Amount appropriated by act of August 17, 1894	25,000.00
Amount available for fiscal year ending June 30, 1895	27,510.40
Amount (estimated) required for completion of existing project	81,900.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	81,900.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix J J 15.)

16. Port Washington Harbor, Wisconsin.—The natural channel at the mouth of the Sauk River was narrow, and at the shoalest point had a depth of but 1 foot.

The original project for the improvement of this harbor was adopted in 1869, and provided for two parallel piers, extending to 10 feet of water in Lake Michigan, and the excavation of an interior basin. This plan was modified in 1870 and again in 1876, and now provides for the excavation of two interior basins, with a combined area of 5¾ acres, with a depth of 12 feet, and a channel of the same depth connecting the basins with the lake.

The total expenditure up to June 30, 1893, was $183,751.05, and resulted in the construction of a north and south pier 920 and 1,226 feet long, respectively, with 400 feet of revetment along the north bank of the river, extending to the inner end of the south pier; in the formation of two interior dredged basins of 2¾ and 3 acres respectively. The north basin had a depth of 12 feet over nearly its entire area, and a narrow channel 12 feet in depth from abreast the inner end of the north pier to the upper end of the west basin, although the average depth did not exceed 8 feet.

There was expended during the fiscal year ending June 30, 1894, $63 for minor repairs to piers.

Soundings taken in March, 1894, indicated a ruling depth of water in the entrance channel of 10 feet.

The estimate for year ending June 30, 1896, is $12,000, for restoration and maintenance of channel and repairs to piers.

July 1, 1893, balance unexpended	$285.45
June 30, 1894, amount expended during fiscal year	63.00
July 1, 1894, balance unexpended	222.45
Amount appropriated by act of August 17, 1894	5,000.00
Amount available for fiscal year ending June 30, 1895	5,222.45
Amount that can be profitably expended in fiscal year ending June 30, 1896 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	12,000.00

(See Appendix J J 16.)

17. Harbor of refuge at Milwaukee Bay, Wisconsin.—The project for the work was approved in 1881, and contemplated the formation of an artificial harbor, inclosing a portion of Lake Michigan forming Milwaukee Bay, within a breakwater of crib work upon a stone foundation. This harbor will furnish 417 acres of safe mooring ground beyond the 18-foot contour and about twice this area beyond the 12-foot contour.

The actual length of the breakwater when completed will be 7,250 feet.

Work began in 1881, and up to June 30, 1893, there had been expended $480,717.62, resulting in the completion of 4,150 running feet of substructure and 3,850 feet of superstructure.

During the fiscal year ending June 30, 1894, one 100-foot crib was sunk in the gap left by the overthrow of two adjoining 50-foot cribs, 400 linear feet of new superstructure was constructed, 1,500 linear feet of old superstructure badly damaged by the storm of April, 1893, was rebuilt, and the outer arm, 1,950 feet in length, was reenforced by stone thrown in against both lake and harbor sides. The amount expended for the above work and for light-ship at south end of breakwater during the fiscal year was $81,626.34.

The length of the substructure (crib and stone foundation) is now

4,250 feet, and of the superstructure 4,150 feet, leaving 3,000 feet of substructure and 3,100 feet of superstructure to be constructed to complete the work.

The harbor is now used to a considerable extent as a shelter from easterly and northeasterly storms, and its value will rapidly increase as the breakwater is extended.

The estimate for the year ending June 30, 1896, for continuing the project is $188,737.91.

July 1, 1893, balance unexpended	$85, 544. 47
June 30, 1894, amount expended during fiscal year	81, 626. 34
July 1, 1894, balance unexpended	3, 918. 13
Amount appropriated by act of August 17, 1894	45, 000. 00
Amount available for fiscal year ending June 30, 1895	48, 918. 13
Amount (estimated) required for completion of existing project	188, 737. 91
Amount that can be profitably expended in fiscal year ending June 30, 1896	188, 737. 91
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix J J 17.)

18. Milwaukee Harbor, Wisconsin.—The original depth of water at the mouth of the Milwaukee River was not more than 3½ feet.

The original project was adopted in 1852, and was directed to securing 12 feet of water at the entrance to the river and to protecting the channel by parallel piers. In 1868 this was modified so as to secure a channel 18 feet deep by extending the piers 600 feet and dredging. The project has been completed, and consequently the only expenditures now demanded are for the maintenance of the piers by timely repairs and of the depth of the channel by dredging.

Up to the close of the fiscal year ending June 30, 1893, there had been expended on this harbor $331,896.09, in addition to $321,355.66 expended by the city of Milwaukeee, resulting in the completion of the modified project of 1868.

During the fiscal year ending June 30, 1894, $6,870.55 has been expended in taking soundings and in repairs.

Soundings taken in March, 1894, show that between the piers there is a channel 100 feet wide and slightly more than 16 feet deep.

The estimate for the year ending June 30, 1896, for repairs to piers and for dredging is $20,000.

July 1, 1893, balance unexpended	$7, 529. 27
June 30, 1894, amount expended during fiscal year	6, 870. 55
July 1, 1894, balance unexpended	658. 72
Amount appropriated by act of August 17, 1894	7, 000. 00
Amount available for fiscal year ending June 30, 1895	7, 658. 72
Amount that can be profitably expended in fiscal year ending June 30, 1896	20, 000. 00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix J J 18.)

19. Racine Harbor, Wisconsin.—The entrance to this harbor originally varied in depth from absolute closure after storms to about 6 feet.

The original project was adopted in 1842 or 1843, and contemplated a channel 12 feet deep. In 1866 the project was modified to provide a channel 15 feet deep.

The project was further modified in 1889, providing for 300 feet extension to the north pier, 500 feet to the south pier, and an increase of channel depth of water to 16 feet.

There had been expended up to June 30, 1893, $265,969.21 in the construction of a north and south pier 1,460 and 1,270 feet long, respectively, and in dredging the channel to 16 feet depth of water.

The work done during the fiscal year ending June 30, 1894, consisted in extending the north pier 150 feet and the south pier 100 feet, in repairing the (old) end of the north pier damaged by collision, and in dredging a channel between the piers 60 feet wide and 14½ deep. The amount expended on the above work during the fiscal year was $23,751.34. To complete the pier extension contemplated by the modified project of 1889 there remain to be constructed 150 linear feet of north pier and 200 linear feet of south pier.

The constant shoaling of the entrance to this harbor shows that until these pier extensions are finished it will be impossible to secure a permanent channel of the projected depth. About 1,100 feet of the superstructure of the piers should be rebuilt.

The estimate for the year ending June 30, 1896, for completing present project, including $17,000 for repairs to piers and for dredging, is $36,500.

July 1, 1893, balance unexpended	$23,815.79
June 30, 1894, amount expended during fiscal year	23,751.34
July 1, 1894, balance unexpended	64.45
Amount appropriated by act of August 17, 1894	20,000.00
Amount available for fiscal year ending June 30, 1895	20,064.45
Amount (estimated) required for completion of existing project	19,500.00
Amount (estimated) required for repairs and maintenance	17,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	36,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix J J 19.)

20. Kenosha Harbor, Wisconsin.—The original depth of water at the mouth of Pike Creek varied from nothing to 3 feet.

The original plan of improvement was adopted in 1852, and was directed to securing a channel 12 feet deep by constructing parallel piers and dredging between them. This plan was modified in 1866 so as to secure 15 feet of water by extending the piers and dredging deeper.

A further modification of the project was made in 1889, providing for the extension of the north pier 300 and the south pier 600 feet.

The amount expended upon this harbor up to June 30, 1893, resulted in the construction of two piers, north and south, 1,600 and 950 feet in length, respectively, 150 feet apart, with a channel of varying depth. In 1875 and 1876 the channel was dredged to 15 feet, but subsequent appropriations sufficed only to maintain a channel of about 12 feet. An area of about 3 acres was also dredged in the inner harbor to a depth of 14 feet.

The work done during the fiscal year ending June 30, 1894, consisted in extending the north pier 100 feet and the south pier 50. The amount expended on this work was $14,814.44. To complete the pier extension contemplated by the modified project of 1889 there remain to be constructed 200 linear feet of north pier and 400 linear feet of south pier. The present channel between the piers and through the bar between the pier heads carries only 13 feet, and until the piers are extended as contemplated in the project it will be impossible to maintain a channel of the projected depth (15 feet). It is proposed to dredge at once about 4,000 cubic yards of material to secure a channel 60 feet wide and 14½ feet deep.

The estimate for the year ending June 30, 1896, for completing present project, including $20,000 for repairs to piers and for dredging, is $54,500.

July 1, 1893, balance unexpended	$15,848.44
June 30, 1894, amount expended during fiscal year	14,814.44
July 1, 1894, balance unexpended	1,034.00
Amount appropriated by act of August 17, 1894	15,000.00
Amount available for fiscal year ending June 30, 1895	16,034.00
Amount (estimated) required for completion of existing project	34,500.00
Amount (estimated) required for repairs and maintenance	20,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	54,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix J J 20.)

21. Waukegan Harbor, Illinois.—Previous to the improvement there was no navigable channel or natural harbor at this place, the adopted project contemplating the construction of an artificial harbor.

A project was adopted in 1852 which provided for the construction of a breakwater parallel to the shore in 20 feet of water. One crib was placed in position, but was carried away by a storm.

The present project was adopted in 1880, and provides for the construction of an exterior basin of sufficient capacity for local trade, by inclosing a portion of Lake Michigan with pile piers, the entrance channel between the piers and the inclosed area to be dredged to 12 feet.

There has been expended on this harbor up to the close of the fiscal year ending June 30, 1893, $148,155.20, resulting in the construction of 2,878.5 feet of pile pier and the removal of 140,880.6 cubic yards of material from the entrance channel and basin.

The work done during the fiscal year ending June 30, 1894, consisted in extending the north pier 216 feet and the south pier 160 feet. The amount expended for this work and for care of harbor and property during the fiscal year was $22,961.57.

The north pier is completed; the south pier lacks 238 feet of the projected length. Soundings taken in April, 1894, show the depth in the basin and channel to be 10 feet.

The estimate for the year ending June 30, 1896, for completing present project, dredging channel and basin, and repairing piers, is $41,000.

July 1, 1893, balance unexpended	$26,844.80
June 30, 1894, amount expended during fiscal year	22,961.57
July 1, 1894, balance unexpended	3,883.23
Amount appropriated by act of August 17, 1894	20,000.00
Amount available for fiscal year ending June 30, 1895	23,883.23
Amount (estimated) required for completion of existing project	41,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	41,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix J J 21.)

22. Fox River, Wisconsin.—The works for the improvement of the Fox River were purchased by the United States from the Green Bay and Mississippi Canal Company in 1872. With the exception of 1 stone lock they were all temporary structures, and were in bad condition. There was no low-water navigation on the Upper Fox, and on the Lower Fox navigation was uncertain.

The adopted project for the improvement of the Fox River contemplated the replacing of the temporary structures with permanent works, the construction of 5 additional locks on the upper river, and widening and deepening the channels throughout the river and canals to 6 feet depth and 100 feet width. The estimate for both rivers made in 1874 and 1876, was $3,745,663.

The work is now carried on under the project of a Board of Engineers submitted September 17, 1884, published in the Annual Report of the Chief of Engineers for 1885, approved by the Secretary of War December 10, 1885, as further modified by authority of the Chief of Engineers May 14, 1886.

The project provides for the renovation of 11 old locks, the deepening and widening of the channel of the Fox River from Montello to Green Bay to 6 feet depth and 100 feet width, and that from Portage to Montello 4 feet of water at low water be maintained. The estimate for this was $602,000.

The amount expended on the Fox and Wisconsin rivers from 1867 up to the close of the fiscal year ending June 30, 1893, including $145,000 paid to the Green Bay and Mississippi Canal Company for works of improvement under act of June 10, 1872, was $2,665,000, and under modified project for the Fox River, $315,747.53, making a total of $2,980,747.53.

The result of the expenditure upon the Fox River was: The construction of 14 new locks of stone; 16 dams, 3 of which are temporary; 12 cut-offs; a head wall and feeder at the old first lock at Appleton; a wing dam of brush and stone for shore protection to the Portage Levee; guard gates at head of Kaukauna Canal; rebuilding canal banks at Kaukauna; a channel 75 feet wide and 450 feet long by blasting and dredging the rock bar below DePere lock to from 4 to 12 inches below the top of the lower miter sill; channel below DePere excavated to 12½ feet depth for a width of from 50 to 60 feet; deepened channels at mouth of Fond du Lac River; Neenah Channel; Fox River at head of Lake Butte des Morts; Grignon Rapids; below Little Chute and Rapide Croche locks; and in the canals and Upper Fox River.

If it were not for the millers at Menasha and Kaukauna drawing the water down below the crests of the dams, boats drawing full 6 feet could have run at any time during the season of navigation from Oshkosh to Green Bay. At Menasha the water stood below the crest of the dam from the middle of July, 1893, continuously to the early part of April, 1894, and at times it was as much as 1½ feet below. At Kaukauna there were times when there was not 2 feet of water on the breast wall of the first lock. Navigation is absolutely at the mercy of the water users. A suit brought by the United States eight years ago to restrain the water users at Menasha and Neenah from drawing the pool below the crest of the Menasha Dam is still pending, and until it is decided in favor of the United States navigation can only be expected to languish.

Navigation was closed by ice on the Upper Fox on November 15, 1893, and on the Lower Fox on November 22, 1893, and resumed on both rivers on April 20, 1894.

During the fiscal year ending June 30, 1894, $34,918.39 was expended and the following work done: The new lock at Portage finished; dredging in Grignon Rapids, and in the river between Rapide Croche Dam and Wrightstown bridge, completed; a masonry wasteweir and culvert at head of combined lock constructed; wing-walls at Kaukauna fourth lock rebuilt, and 587 linear feet of cement-laid rubble masonry core-wall constructed in the canal banks of the fourth and fifth levels at Kaukauna; and minor repairs made to locks, dams, lock houses, boats, and dredges.

An appropriation of $100,000 is recommended for the fiscal year ending June 30, 1896.

July 1, 1893, balance unexpended	$50,420.86
June 30, 1894, amount expended during fiscal year	34,918.39
July 1, 1894, balance unexpended	15,502.47
July 1, 1894, outstanding liabilities	2,464.37
July 1, 1894, balance available	13,038.10
Amount appropriated by act of August 17, 1894	37,500.00
Amount available for fiscal year ending June 30, 1895	50,538.10
Amount (estimated) required for completion of existing project	243,250.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	100,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

(See Appendix J J 22.)

23. Operating and care of locks and dams on Fox River, Wisconsin.—Under the continuous appropriation for operating and care of canals and other works of navigation, it is proposed to maintain existing navigation by timely repairs to old locks until they are replaced by new, and to continue repairs of works that have already been completed and used, injured by floods or otherwise.

During the fiscal year ending June 30, 1894, $36,958.24 has been expended, the detailed statement appended to the report of the local engineer officer showing the items of expenditure.

(See Appendix J J 23.)

24. Removing sunken vessels or craft obstructing or endangering navigation.—Wreck of schooner Mount Vernon, Root River, Racine, Wis.—As this vessel was sunken in the Root River, near the head of the navigable channel, it was an obstruction to navigation. On March 5, 1894, the wreck was floated and hauled out on the bank of the river under contract, and is no longer an obstruction to navigation. Subsequently, April 5, 1894, the wreck was sold at public auction, the net proceeds of the sale being $15.32. The total cost of the work was $210.54.

(See Appendix J J 24.)

IMPROVEMENT OF CHICAGO AND CALUMET HARBORS AND ILLINOIS RIVER, ILLINOIS, AND CALUMET RIVER, ILLINOIS AND INDIANA; ILLINOIS AND MISSISSIPPI CANAL.

This district was in the charge of Capt. W. L. Marshall, Corps of Engineers, having under his immediate orders Lieut. Henry Jervey, Corps of Engineers, the entire year, and Lieut. Chester Harding, Corps of Engineers, to May 2, 1894; Division Engineer, Col. O. M. Poe, Corps of Engineers.

1. *Chicago Harbor.*—The present project was adopted in 1870, and contemplated—

a. The formation of an outer harbor or basin, by inclosing a portion of Lake Michigan just south of and adjoining the entrance to Chicago River, for the purpose of increasing the harbor facilities of Chicago.

b. The construction of an exterior breakwater in deep water north of the entrance to Chicago River and about 1 mile distant, to shelter the approach to the river and outer harbor entrance, and to form a harbor of refuge at the southern end of Lake Michigan.

The expenditures upon this project since 1870 have resulted in the completion of the outer harbor, except 267,000 cubic yards of dredging still remaining to be done to attain 16 feet depth of water at low water throughout the required basin; in the completion of the exterior breakwater, 5,413 feet in length; in keeping the entrance to Chicago River, which constitutes the inner harbor of Chicago, dredged; in maintaining the various piers and breakwaters, and in maintaining in serviceable condition the plant pertaining to the work.

During the fiscal year ending June 30, 1894, no work was done upon the exterior breakwater, it having been completed. At the outer basin and south pier, Chicago Harbor, the contract with the Wisconsin Dredge and Dock Company, of Manitowoc, Wis., for rebuilding superstructures over southerly breakwater outer basin, and south pier, Chicago Harbor, was continued until the work contracted for was completed. There were placed in the work 852,033 feet, B. M., of pine timber, 103.29 cords of stone, 56 piles in clumps of seven, 648 pounds dredge chain, 576 screw bolts, and 94,230 pounds iron driftbolts. The piers at the entrance to Chicago River seaward of the shore line and of the outer basin are now practically new and in excellent condition, except over 500 linear feet of the southerly breakwater which will soon need rebuilding. The older piers that are now within the shore line, due to natural and artificial accretions to the land, are in bad condition and have been practically abandoned by the United States as forming part of the dockage of Chicago River, except that portion of the south pier forming the north limit of the Illinois Central Railroad docks.

In the last Annual Report of the Chief of Engineers the superstructure over the exterior breakwater was reported as in greater part in need of rebuilding. This superstructure was damaged throughout by the great storm of May 18, 1894, and immediate and expensive repairs are needed to this superstructure in order to save the now remaining sound parts, the newer as well as the older work having sustained damage. The estimate now made for repairs will have to be materially increased if repairs can not be made before the next winter's storms.

The estimate submitted is for superstructure over 3,240 linear feet of the exterior breakwater originally constructed in 1881–1883, for repairing damages to the more recent work, and for refilling with stone and covering the entire structure with a decking 6 inches thick. It is now more economical to continue the use of crib work filled with riprap, and on that basis the estimates are submitted.

There is also a large amount of dredging to be done in the outer basin, estimated at 267,000 cubic yards, to gain 16 feet of water in the harbor beyond the dock lines. This work is not pressing, as the outer harbor is not used for commercial purposes to any extent and further work thereon beyond maintenance should await the demand for some useful purpose.

The estimate submitted also provides for means for keeping the entrance to Chicago Harbor dredged and the contingency of an increase in damage to the exterior breakwater due to delay in repairs thereto.

July 1, 1893, balance unexpended	$62, 780. 59
June 30, 1894, amount expended during fiscal year	35, 331. 17
July 1, 1894, balance unexpended	27, 449. 42
July 1, 1894, outstanding liabilities	200. 00
July 1, 1894, balance available	27, 249. 42
Amount appropriated by act of August 17, 1894	80, 000. 00
Amount available for fiscal year ending June 30, 1895	107, 249. 42
Amount (estimated) required for maintenance	100, 000. 00
Amount that can be profitably expended in fiscal year ending June 30, 1896	100, 000. 00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix K K 1.)

2. *Calumet Harbor, Illinois.*—This improvement is to furnish a safe and practicable entrance to Calumet River and the port of South Chicago by parallel piers 300 feet apart, extending from shore to deep water in the lake, and by dredging between them to 16 feet in depth at low water.

The work commenced in 1870, and at the close of the fiscal year ending June 30, 1894, there had been expended $441,262.30, as the result of which 3,640 linear feet of the north pier and 2,020 linear feet of the south pier have been completed, and 471,364 cubic yards of material dredged, giving a channel 16 feet in depth instead of 7 feet, as originally existed.

The channel is now 250 feet in width, 16 feet in depth below extreme low water in Lake Michigan, and extends from a similar depth in Lake Michigan to the beginning of the 16-foot channel in the Calumet River.

During the fiscal year ending June 30, 1894, the contract entered into the previous year for rebuilding superstructure over 1,600 linear feet of pier work and for 320 linear feet of sheet piling was completed, requiring for completion only the sheet piling 286 linear feet, the Calumet and Chicago Canal and Dock Company having built the remainder of the 320 feet in connection with the angle of their new dock.

One thousand eight hundred and thirty-seven feet of superstructure is in a deplorable state of decay and needs immediate renewal, in addition to which there are 634 linear feet of superstructure over pier work in bad condition.

The south pier should be prolonged 800 feet, but it is not advisable to undertake new work until the existing piers are put in good condition.

The estimate submitted is therefore for repair and maintenance only, the project for this harbor as far as approved having been completed.

July 1, 1893, balance unexpended	$10, 380. 94
June 30, 1894, amount expended during fiscal year	4, 243. 24
July 1, 1894, balance unexpended	6, 137. 70
July 1, 1894, outstanding liabilities	104. 44
July 1, 1894, balance available	6, 033. 26
Amount appropriated by act of August 17, 1894	15, 000. 00
Amount available for fiscal year ending June 30, 1895	21, 033. 26

Amount (estimated) required for maintenance	$30,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	30,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

(See Appendix K K 2.)

3. *Calumet River, Illinois and Indiana.*—The object of this improvement as far as projected is to secure a channel 200 feet in width and 16 feet in depth below low-water plane in Lake Michigan, from the mouth of the Calumet River, at Calumet Harbor, Illinois, to one-half mile east of Hammond, Ind., with a view to increasing the facility for handling the commerce of this region, and also to aid in providing means for the better accommodation of much of the commerce of Chicago River, which river is very much crowded. The original depth of navigation in this river varied from 6 to 10 feet.

The various acts of Congress and the limitations made by law upon the expenditure of the appropriations thereby made before work was systematically inaugurated upon this improvement are given in the Annual Report of the Chief of Engineers for the year ending June 30, 1889.

Since the beginning of the improvement there has been removed 1,650,898 cubic yards of material, making a channel 3 miles and 3,330 feet in length, of which a short portion, where rock and other undredgeable material was encountered, is incomplete, there remaining less than 9,000 cubic yards to be removed.

This material can be most economically removed after all of this class shall have been revealed by further work.

The amount expended by the United States to the close of the fiscal year ending June 30, 1894, is $245,167.13, of which $204,754.67 has been expended below the forks of the Calumet, including $5,000 paid for legal expenses in securing rights of way and releases from damages due to the proposed improvement, required by the act of July 5, 1884, and $40,412.46 for work between the forks of the Calumet River and one-half mile east of Hammond, Ind.

During the fiscal year ending June 30, 1894, there were dredged under contract 421,480 cubic yards from the channel below the forks and 91,962 cubic yards from the channel between the forks of the Calumet and one-half mile east of Hammond, Ind. Part of the dredging below the forks was in restoring the channel which has materially deteriorated. Twenty thousand nine hundred and forty-six cubic yards of this latter dredging was under a contract that is still in progress, and was not paid for during the fiscal year.

The fill due to rains and to floods in the Calumet River, and the sewage and filth from houses and manufacturing establishments rapidly reduces the depths attained by dredging. The estimates submitted to Congress are for once securing the desired channel, but in some cases, especially on the section above the Forks, the channel has been thrice dredged and is now no better than before the work was inaugurated.

Below the Forks there has been a deposit of 25 per cent of the total dredging done. Without repeated redredging the channel will speedily revert to its original area of cross-section or discharge capacity.

The improvement of the lower section of this river has resulted in attracting many enterprises of magnitude depending upon marine commerce for prosperity, and there are evidences of increased activity in the direction of development here, especially in the construction of elevators for handling a large part of the grain trade of Chicago.

The estimate submitted is for redredging the channel below the

Forks, and extending the work southward from One hundred and eighteenth street.

July 1, 1893, balance unexpended	$72,156.01
June 30, 1894, amount expended during fiscal year	62,323.14
July 1, 1894, balance unexpended	9,832.87
July 1, 1894, outstanding liabilities	2,241.21
July 1, 1894, balance available	7,591.66
Amount appropriated by act of August 17, 1894	45,000.00
Amount available for fiscal year ending June 30, 1895	52,591.66
Amount (estimated) required for completion of existing project	700,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	200,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

(See Appendix K K 3.)

4. *Illinois River, Illinois.*—The present project was adopted in 1880, and contemplates the extension of the slack-water improvement begun by the State of Illinois, from the mouth of Copperas Creek to the Mississippi River, a distance of about 135 miles.

The project includes the construction of two locks 350 feet long between miter sills, 75 feet in width of lock chamber, with a depth of 7 feet of water over sills at low-water level of 1879, and dredging the channel where necessary to secure 7 feet depth of water at low water in the pools thus created.

The two locks and dams have been completed and are in use. They are situated, one at Kampsville, 31 miles above the mouth of the Illinois, the other at La Grange, 79 miles above the mouth of the river.

The ultimate object of the improvement is the construction of a waterway from the southern end of Lake Michigan to the Mississippi River of sufficient capacity to accommodate large-sized Mississippi River steamboats, and for military and naval purposes.

The State of Illinois, aided by the United States, has executed part of the project by the construction of two locks of the dimensions above stated, one at Henry, and one at Copperas Creek, respectively, completing, excepting dredging, that part of the improvement between La Salle, Ill., and the mouth of Copperas Creek.

In executing the work, the United States have expended up to June 30, 1894, $1,279,279.69, including $25,000 from the appropriation of August 11, 1888, for surveys, and excluding $62,359.80 expended upon the foundation of Copperas Creek Lock, afterwards completed by the State of Illinois.

An additional amount of $747,747 was expended by the State of Illinois at Henry and Copperas Creek locks.

During the fiscal year ending June 30, 1894, the following work was done:

Kampsville Lock.—The approaches to the lock were dredged, and the cofferdam removed; the gates diked; the lock walls strengthened at the wing walls by dry rubble backing. Crib guides and pile clumps placed at the head of the lock; the filling behind lock walls completed; the maneuvering gear placed and the lock opened to navigation.

Kampsville Dam.—Work was resumed on this dam July 10; the channel closed for navigation August 19; navigation through the lock begun August 29, and the dam completed September 30, 1894. The filling behind the abutment of the dam and the levee to prevent cutting behind the dam constructed, and the United States lands fenced.

The dam is 1,200 feet in length and 7.4 feet lift.

Forty two thousand one hundred and eighty-nine cubic yards of dredging was done, including the dredging of Hurricane Island Bar.

Plant.—Two barges were built of old material from the traveler trestles; a set of ways were constructed for hauling out the floating plant for repairs, and both dredges; the steamer *Enterprise* and the office boat thoroughly repaired, and new gates placed in the dump scows; a small building was constructed for a bakery.

There remains to be done at this lock the following work: Two buildings for lock tenders' quarters, and revetments below the east abutment and below the lock; also a few clumps of guide piles.

At La Grange Lock there is still one building for lock-tenders to be erected.

To complete the improvement there remains dredging to the amount of 2,000,000 cubic yards between Copperas Creek and the mouth of the Illinois.

This work is necessary in any event, and to complete it will require an increase in the dredging plant and new hulls for the dredges now on hand. For these and other reasons heretofore stated the balance ($77,500) of the original estimate for this work will not be sufficient to complete the dredging. There are also many snags and logs in the channel, and provision for a snagging outfit for this river is essential.

July 1, 1893, balance unexpended		$76,844.14
June 30, 1894, amount expended during fiscal year	$69,745.12	
August, 1893, refunded Capt. Marshall, account erroneous deposit, 1892	5.50	
		69,750.62
July 1, 1894, balance unexpended		7,093.52
July 1, 1894, outstanding liabilities		1,697.28
July 1, 1894, balance available		5,396.24
Amount appropriated by act of August 17, 1894		35,000.00
Amount available for fiscal year ending June 30, 1895		40,396.24
Amount (estimated) required for completion of existing project		77,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1896		77,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.		

(See Appendix K K 4.)

5. *Operating and care of La Grange and Kampsville Locks and Dams, Illinois River.*—These locks and dams have been maintained and operated under the general indefinite appropriation "for operating and care of canals and other works of navigation" contained in section 4 of the river and harbor act of July 5, 1884—the La Grange Lock throughout the year and the Kampsville Lock since the completion of the dam, September 30, 1893.

La Grange Lock.—The work at this lock consisted in operating the lock; repairing damages to the levee above the lock; rebuilding the ice-breaker crib that had been damaged by ice; placing 3,000 cubic yards of filling about the lock-tenders' quarters; repairing and strengthening the Head Bay platform, and in laying necessary drain tile for draining the stagnant depression back of the lock house.

Additional snubbing posts were placed on the lock walls; the ice house rebuilt, and two temporary buildings erected for quarters for laborers engaged in repairs to the lock.

The necessary dredging to maintain the approaches to the lock was done and the buildings and grounds kept in order.

Kampsville Lock.—The first boat passed through this lock August 29, 1893. The lock has been operated and maintained since that date.

A broken stone drain was built along the lock wall its full length to carry off surface water. The step stones and coping about the pier heads were doweled; 17 snubbing posts set; wooden fenders placed to protect the gates from blows from boats, and the approaches to the lock dredged.

The tonnage is less than in 1893, but the locks were closed to navigation for three months due to the construction of Kampsville Lock and the repairs at La Grange Lock. For similar months there was an increase in tonnage.

The number of craft passing La Grange Lock increased from 432 in 1892 to 475 in 1893 and to 509 in 1894.

The amount expended during the fiscal year 1894 was for both locks $15,495.32, including $994.57 outstanding liabilities at end of fiscal year.

(See Appendix K K 5.)

6. *Illinois and Mississippi Canal, Illinois.*—The object of this improvement is to furnish a link in a navigable water route from Lake Michigan, at or near Chicago, Ill., to the Mississippi River, at the mouth of Rock River.

The canal is located upon the route approved by the Secretary of War October 27, 1888, from the Illinois River, about 1¾ miles above the town of Hennepin, at the great bend of the Illinois River; thence via Bureau Creek Valley to Rock River at Penney Slough; thence by slack water and a short canal around the lower rapids of Rock River, to its mouth. The canal is to be 80 feet wide at the water surface, 7 feet deep, and with lock chambers 170 feet in length and 35 feet in width.

A report upon the detailed location, plans, and estimates for the construction of this canal was submitted June 21, 1890, and published by Congress as House Ex. Doc. No. 429, Fifty-first Congress, first session.

The river and harbor act of September 19, 1890, made the first appropriation for the construction of this canal, and directed work to be begun by the construction of one of the locks and dams on Rock River.

Work was commenced on this canal in July 1892, near the mouth of Rock River and since that date has been prosecuted. There has been expended on the work up to the close of the fiscal year ending June 30, 1894, $459,869.35, which has resulted in—

(1) The acquirement of the right of way for 4½ miles around the lower rapids of Rock River, and the near completion of the work there.

(2) In the location on the ground, and the preparation of plats and descriptions of all lands needed for the eastern section as far as to the feeder junction, and the acquirement of title to the first 8 miles of the right of way thereof, by condemnation.

(3) In the survey of a new route from the feeder junction to Rock River and the preparation of estimates along that line.

During the past fiscal year the following work has been done:

All contracts in force at the end of the last fiscal year were completed. Three locks, 7 sluiceways, 1 culvert, and the abutments for 1 ponton bridge have been completed and the earthwork and rock excavation of the canal around the lower rapids of Rock River nearly completed.

Material has been purchased and is on hand for the dams across Rock River and the base of the north dam is in place.

Material for piers and abutments of the two bridges across the canal at Milan has been purchased and delivered, and the bridge superstructures contracted for. The gates of the three locks and seven sluiceways have been framed and all placed except the gates for Lock 37.

It is expected that this part of the canal will be completed ready for navigation before the close of the present working season.

Eastern section.—The right of way for 8 miles of the canal has been obtained by condemnation. The descriptions and abstracts of title of lands required for the next 8 miles are in the hands of the district attorney, and for the remainder of the 24 miles of this section ready to submit to the Department of Justice for the necessary proceedings to acquire title. The survey for an alternative route from feeder junction to Rock River was completed and the comparative estimates of costs made, and the detailed location, borings, and estimates for the construction of the eastern section well advanced.

Nothing has been done at the feeder line. As soon as the canal around the lower rapids of Rock River is completed the feeder will be definitely located and construction thereof begun when money is appropriated therefor. It would be advantageous in the construction of the canal for the feeder to be completed at or before the completion of the eastern section to utilize the eastern section of the canal for transportation of material, etc., for the construction of that part of the western section from the summit level to Rock River.

The construction of the first 8 miles of the eastern section will begin this season, and upon the extension of the right of way obtained work may be more rapidly carried on and appropriations advantageously increased.

July 1, 1893, balance unexpended		$810,183.61
June 30, 1894, amount expended during fiscal year	$269,266.50	
August, 1893, refunded Capt. Marshall on account erroneous deposit, 1892	.50	
		269,267.00
July 1, 1894, balance unexpended		540,916.61
July 1, 1894, outstanding liabilities	$28,062.26	
July 1, 1894, amount covered by uncompleted contracts	11,200.00	
		39,262.26
July 1, 1894, balance available		501,654.35
Amount appropriated by act of August 17, 1894		190,000.00
Amount available for fiscal year ending June 30, 1895		691,654.35
Amount (estimated) required for completion of existing project		5,735,960.00
Amount that can be profitably expended in fiscal year ending June 30, 1896		1,000,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.		

(See Appendix K K 6.)

IMPROVEMENT OF CERTAIN RIVERS AND HARBORS IN MICHIGAN AND OF MICHIGAN CITY HARBOR, INDIANA.

This district was in the charge of Maj. William Ludlow, Corps of Engineers, to November 20, 1893, and of Lieut. Col. G. J. Lydecker, Corps of Engineers, since that date; Division Engineer to November 22, 1893, Col. O. M. Poe, Corps of Engineers.

1. *Michigan City Harbor, Indiana.*—The improvement of this harbor dates from 1836, and has resulted in establishing a convenient "inner harbor" for local commerce, and partly completing an "outer harbor"

designed to facilitate entrance to the former, and afford refuge in times of northerly gales to vessels engaged in general lake commerce.

The inner harbor has been made by (1) deepening the entrance to Trail Creek, and protecting the channel by piers extending to deep water in Lake Michigan, to which operations were limited until 1870; and (2) prolonging the entrance channel up the creek, by dredging between revetments that are built on established dock lines at the expense of the adjoining property, as required by city ordinance. This work, commenced in 1882, and still in progress, has thus far resulted in an interior waterway over 7,000 feet long, between substantial revetments from 125 to 175 feet apart, with turning basins about 350 feet wide at suitable intervals. A further extension of 1,300 feet is required to complete as now proposed. The cost of all work done in connection with the "inner harbor," from 1836 to June 30, 1893, was $115,418.98.

The amount spent during the last fiscal year was $3,443.48. This was applied to dredging for maintaining the requisite navigable depth, the amount dredged being 27,231 cubic yards, resulting in the removal of all shoals and providing a full 13-foot channel throughout the limits of the interior improvement; also in deepening the entrance from 13½ to 17 feet. Some decking torn from the west harbor pier during a severe gale May 18 was replaced.

The principal requirements for extending and maintaining this harbor are dredging and repairs to old piers at entrance. The section of the old east pier beyond the shore line has hardly any timber work left above the water line, and for a length of about 125 feet its top is several feet below water. The filling of the old west pier for a distance of 500 feet has gone to below the water surface. This section comprises the most exposed part of the work and must be refilled. The estimate for the inner harbor for 1896 is therefore as follows: For rebuilding above water 850 feet of old east pier, for refilling outer section of west pier and minor repairs to the same, and for dredging.

July 1, 1893, balance unexpended	$8,956.02
June 30, 1894, amount expended during fiscal year	3,443.48
July 1, 1894, balance unexpended	5,512.54
July 1, 1894, outstanding liabilities	1,066.32
July 1, 1894, balance available	4,446.22
Amount appropriated by act of August 17, 1894	10,000.00
Amount available for fiscal year ending June 30, 1895	14,446.22
Amount that can be profitably expended in fiscal year ending June 30, 1896 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	20,000.00

The outer harbor.—This comprises an outer basin of some 40 acres located to the east of the entrance to the inner harbor, and an exterior detached breakwater to the westward designed to give increased safety to vessels entering during heavy weather; and the combination, when completed, is intended to provide a safe "harbor of refuge" against northerly gales, for general commerce. The structures inclosing the basin comprise a pile pier 1,225 feet long, a crib breakwater 30 feet wide, 1,215 feet long, and a breakwater pier 30 feet wide, 500 feet long; in all, 2,940 feet. These were completed from 1870 to 1885, and expenditures applied thereto since that time have been for repairs simply.

The "exterior breakwater," projected in 1882 and now under construction, lies in the open lake westward of all other harbor works, and when completed will have a total length of 2,000 feet, comprised in two equal arms, making an interior angle of 130° with each other. One-half of the easterly arm had been completed to June 30, 1893. The total expenditures to that date, for all work applied to constructing the outer harbor, was $718,029.31. Expenditures during the past fiscal year were $4,609.95, most of which was applied to contract work for adding 200 feet to the length of the exterior breakwater; in addition some repairs were made to the "breakwater pier," the principal item of which was labor for equalizing the level of stone filling.

The completion of the exterior breakwater calls for 1,300 feet of crib breakwater 30 feet wide, and when this is done the essential structural elements of a much needed harbor of refuge will be supplied; it is believed to be of vital importance to the safety of general commerce that such a harbor be completed as soon as possible, and it is pertinent to note that its absence contributed to the loss of two large vessels, wrecked in the immediate vicinity during the past winter and spring. Economy of construction and the needs of a vast general commerce urge that the next appropriation suffice to put all the remaining work under contract; the sum essential for this purpose is $215,000, to be applied as follows: For constructing 1,300 feet of breakwater, $195,000; for repairs of all old structures pertaining to the outer harbor, and for engineering superintendence and contingencies, $20,000.

July 1, 1893, balance unexpended		$38,455.64
June 30, 1894, amount expended during fiscal year		4,609.95
July 1, 1894, balance unexpended		33,845.69
July 1, 1894, outstanding liabilities	$10,508.65	
July 1, 1894, amount covered by uncompleted contracts	14,563.73	
		25,072.38
July 1, 1894, balance available		8,773.31
Amount appropriated by act of August 17, 1894		20,000.00
Amount available for fiscal year ending June 30, 1895		28,773.31
Amount (estimated) required for completion of existing project		229,613.50
Amount that can be properly expended in fiscal year ending June 30, 1896		215,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

(See Appendix L L 1.)

2. *St. Joseph Harbor, Michigan.*—The outlet of St. Joseph River into Lake Michigan was originally by a shifting channel with depths fluctuating between 3 and 7 feet. Its improvement by the Government has extended through a period of fifty-eight years, and expenditures for that purpose amounted to $384,523.29 up to June 30, 1893; the total estimated cost of the improvement, when completed as proposed by the revised project of 1892, is $519,113.

The objects sought by the present project are an entrance channel 270 feet wide and 16 feet deep, the extension of the same depth through the harbor, and an interior navigation 13 feet deep from there to Benton Harbor, nearly 1 mile above. The interior navigation is maintained as required by frequent dredgings; the proposed entrance depth of 16 feet has not yet been obtained because of insufficient pier extension, and the actual depth there available generally varies from 14 to 15 feet.

The amount expended during the past fiscal year was $48,290.73. The north pier was thereby extended 350 feet. A breach 180 feet long, made through the pier near the shore line in October, 1893, was rebuilt and minor repairs were made to adjoining portions in order to hold them together until they can be substantially reconstructed. The interior navigation was maintained by dredging 17,935 cubic yards.

The urgent work required at this harbor is pier extension to the amount of 850 feet to complete the present project and rebuilding 375 feet of old crib work that is liable to be carried away by any heavy northeasterly gales; filling of old pile piers is generally gone to, or below, the water surface and must be restored; sheet piling is required on a length of 550 feet of north pile revetment to hold back sand from the harbor channel. The estimate for 1896 is intended to provide for the above and other minor items or repairs and dredging, as follows:

For 850 feet of crib pier extension, $85,000; for rebuilding 375 feet of old north pier, $7,500; for sheet piling and refilling 550 feet of pile work in north pier, $5,500; for refilling 600 feet of south pile pier, $3,000; dredging and minor repairs, $5,000; total, with contingencies, $115,000.

July 1, 1893, balance unexpended	$48, 588. 91
June 30, 1894, amount expended during fiscal year	48, 290. 73
July 1, 1894, balance unexpended	298. 18
July 1, 1894, outstanding liabilities	109. 97
July 1, 1894, balance available	188. 21
Amount appropriated by act of August 17, 1894	30, 000. 00
Amount available for fiscal year ending June 30, 1895	30, 188. 21
Amount that can be profitably expended in fiscal year ending June 30, 1896 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	115, 000. 00

(See Appendix L L 2.)

3. *St. Joseph River, Michigan.*—The approved plan of improvement concerns the stretch of river from its mouth at St. Joseph Harbor to Berrien Springs, 25 miles above. It provides for the removal of sunken logs and snags, closing secondary channels by dams of brush and stone, and wing dams at other points as found necessary, to concentrate the flow of water and maintain a low-water navigation 3 feet deep over the obstructing bars and shoals. The original estimate of cost of improving this section of the river so as to give it a navigable depth of 3 feet was $11,300.

The amount expended to June 30, 1893, was $3,450.27. The channel has thereby been increased from its original depth of about 2 feet to a depth of 3 feet at most of the worst places; but other shoal places remain, and the structures already placed, having necessarily been of a light and inexpensive character, are in need of repairs.

Expenditures during the past fiscal year were $678.97; they were applied to repairing five of the old dams and building four new ones of brush and stone, aggregating about 800 feet in length.

The completion and maintenance of this navigation calls for further dam construction, repairs of existing structures, and the removal of logs and snags, for all of which a sum of $2,500 will be needed.

July 1, 1893, balance unexpended	$1, 049. 73
June 30, 1894, amount expended during fiscal year	678. 97
July 1, 1894, balance unexpended	370. 76
Amount appropriated by act of August 17, 1894	500. 00
Amount available for fiscal year ending June 30, 1895	870. 76
Amount that can be profitably expended in fiscal year ending June 30, 1896 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	2, 500. 00

(See Appendix L L 3.)

4. *South Haven Harbor, Michigan.*—Before improvement by the General Government, the citizens of South Haven had constructed piers and revetments at the mouth of the Black River and thereby obtained a channel into Lake Michigan 6 or 7 feet deep and 85 feet wide. The improvement thus started was taken up by the Government in 1867, under a plan of operations that provided for increasing the channel to a width of 120 feet between piers extended far enough into Lake Michigan to obtain and hold a navigable depth of 12 feet. The original project was subsequently modified to make the entrance width between piers 177 feet, and extend the navigable channel upstream to the highway bridge about half a mile above the piers. The total length of piers and revetments built, up to the year 1888, aggregated 3,145 feet, and no extensions have been made to them since that time.

The estimated cost of all work done, and to be done under the present approved project, is $262,000. The total expenditure to June 30, 1893, was $210,435.52, resulting in the construction and maintenance of piers and revetments indicated in the foregoing paragraph, and in repeated dredgings to provide the requisite channel depth.

The amount expended during the past fiscal year was $6,295.74. Extensive repairs of piers were thereby made, including the rebuilding above water of about 200 feet of old crib work in the south pier. The channel was improved by dredging 23,885 cubic yards between July 31 and October 2, 1893, and again between April 21 and May 14, 1894, when 7,893 cubic yards was excavated; this work left the harbor with a through-channel depth of 12 feet, which may be expected to last fairly well until early autumn.

The maintenance of a 12-foot channel is not to be expected until the piers reach out to the curve of 15 feet depth in Lake Michigan, which will require additions of 250 feet and 450 feet to the north and south piers, respectively. The present approved project provides for doing one-half of this work. Five hundred and twenty-four feet of the old pile work in north pier, being badly decayed, must be rebuilt above water, and 351 feet of old crib work, in the same pier, built over twenty-five years ago, must likewise be entirely rebuilt above water. The interior navigation requires frequent dredging for its maintenance.

The estimate for 1896 is intended to provide for the work above indicated, and for minor repairs, and is as follows: For extending north pier 150 feet, and south pier 200 feet, under existing project, $42,000; rebuilding above water 875 feet north pier, and refilling same, $8,750; refilling piers and minor general repairs, $2,500; dredging, $4,000—making, with contingencies, $62,000.

July 1, 1893, balance unexpended	$6,564.68
June 30, 1894, amount expended during fiscal year	6,295.74
July 1, 1894, balance unexpended	268.94
July 1, 1894, outstanding liabilities	12.50
July 1, 1894, balance available	256.44
Amount appropriated by act of August 17, 1894	20,000.00
Amount available for fiscal year ending June 30, 1895	20,256.44
Amount that can be profitably expended in fiscal year ending June 30, 1896 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	62,000.00

(See Appendix L L 4.)

5. *Saugatuck Harbor, Michigan.*—This harbor is at the mouth of the Kalamazoo River, where the channel depth before improvement was generally not over 5 feet; its condition was first improved by a private

company, which built two slab piers for confining the river current and thereby obtained a channel depth of 7 feet temporarily. Its further improvement was commenced by the General Government in 1869, and from that time to 1882 the piers were extended and interior channel revetments constructed until they had a total length of 1,907 feet on the north and 3,863 on the south side, all of pile work. Since 1882, appropriations having been too small to keep these structures in repair, they have gradually gone to decay, and the navigable channels opened through the harbor from time to time, by dredging, fill up again very soon after the departure of the dredge.

The estimates made for carrying on the work from time to time aggregated $175,699.46, and the total expenditures to June 30, 1893, was $143,100.98, with results as indicated in the foregoing paragraph.

The amount expended during the past fiscal year was $2,259.17, all applied to dredging 28,406 cubic yards.

When this work of dredging commenced the channel depths at entrance and over interior shoals were only from 5 to 6 feet, and the result of operations covering the period between June 13 and July 28, 1893, was to increase these depths to 10 or 12 feet through a narrow channel. They lasted but a very short time, and the dredge was again sent to the harbor September 2, to reopen the entrance channel; work was continued to September 18, when the money available was nearly exhausted and operations were suspended after excavating 4,525 cubic yards, resulting in a narrow channel 13 feet deep through the worst part of the outer bar, and one 10 feet deep through the shoal just inside of the entrance. Survey of the harbor made June 6–9, 1894, showed depths of only 5 to 7 feet on the several bars and shoals, but there were no sufficient funds available for effective work and the result is that the harbor is now practically closed to navigation.

If there be any intention to maintain this as a navigable harbor, a general reconstruction of existing structures is necessary. If an establishment of a navigable depth of 12 feet, as heretofore contemplated, is to be accomplished, the old works must be put in serviceable condition, as above indicated, and both piers extended to the curve of 15-foot depth in Lake Michigan, now distant 1,000 feet and 800 feet from the north and south pier ends, respectively. No estimate for the above work is submitted for the reason that there is no present authority for undertaking it, and the estimate below is therefore confined to that needed for dredging to open temporary channels at times when they are most needed, and for such repairs as are requisite to save the existing works from total destruction.

The estimate for 1896 is, therefore, as follows: For rebuilding 2,800 feet of north and south piers above water, and refilling same, $28,000; for dredging, $5,000; making, with contingencies, $35,000.

July 1, 1893, balance unexpended	$2,268.02
June 30, 1894, amount expended during fiscal year	2,259.17
July 1, 1894, balance unexpended	8.85
July 1, 1894, outstanding liabilities	8.13
July 1, 1894, balance available	.72
Amount appropriated by act of August 17, 1894	12,000.00
Amount available for fiscal year ending June 30, 1895	12,000.72
Amount (estimated) required for completion of existing project	18,260.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	35,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix L L 5.)

6. *Holland (Black Lake) Harbor, Michigan.*—The first steps toward establishing a harbor at this place were taken by the citizens of Holland, Mich., situated on Black Lake, about 5 miles from the present harbor, by opening a channel having a navigable depth of about 5 feet from the lake into Lake Michigan and protecting it by piers and revetments made of brush and stone. Continuation of this improvement was taken in hand by the General Government in 1867, existing structures strengthened by pile and crib work, and extended until, in 1880, the north-side pier and revetment had attained a total length of 850 feet and the south side 1675 feet; they have remained without extension since that time.

The estimated cost of work done, and remaining to be done, to complete the present approved project, was $291,615.13, and the amount expended to June 30, 1893, was $274,620.07. The results thereby attained have been the construction and maintenance of piers and revetments aggregating 35,525 feet in length, covering a channel way from 175 to 220 feet wide, in which a depth of 8 to 9 feet prevails, deepened by occasional dredging to 12 or 13 feet. The dredged channels have but little permanence because the piers are not long enough, and the older portions of them are in such condition as to permit the passage of large quantities of sand through and under them, by which the clear way between them soon fills to a general depth of 8 or 9 feet only.

Expenditures during the past fiscal year were $2,263.26, all applied to dredging; the amount excavated was 12,584 cubic yards, and a channel with a depth of not less than 12 feet and width of 50 feet thereby obtained from Lake Michigan to Black Lake.

The proposed depth of 12 feet can not be maintained until the old work is sheet piled as indicated above, and piers extended to the 15-foot curve in Lake Michigan, which will require an addition of 400 feet to each.

July 1, 1893, balance unexpended	$4,994.05
June 30, 1894, amount expended during fiscal year	2,263.26
July 1, 1894, balance unexpended	2,730.79
July 1, 1894, outstanding liabilities	1,041.57
July 1, 1894, balance available	1,689.22
Amount appropriated by act of August 17, 1894	15,000.00
Amount available for fiscal year ending June 30, 1895	16,689.22

(See Appendix L L 6.)

7. *Grand Haven Harbor, Michigan.*—This harbor is at the mouth of the Grand River, which had a shifting channel, with a depth of 9 feet at its mouth before improvement. The first step in the line of improvement was taken by the Detroit, Grand Haven and Milwaukee Railroad Company, by constructing a pier on the south side, to provide for the interchange of traffic between the railroad and its translake line of steamers. Its systematic improvement was commenced by the Government in 1867, and has resulted in the establishment of a harbor that not only satisfies the needs of an extensive local commerce, but gives to general commerce its only harbor of refuge from westerly gales on this coast south of Grand Traverse Bay. This important quality is due to the established width of 400 feet between the piers at entrance and the maintenance there of a channel depth of about 18 feet.

The estimated cost of work done and remaining to be done to complete the harbor, as provided in the approved project amounts to

$804,366.15, and the total expenditures thereon to June 30, 1893, were $638,200.20.

The works of improvement thereby built and kept in repairs comprise a north pier and revetment aggregating 3,187 feet in length, projecting 1,215 feet beyond the shore line; and a south pier and revetment 5,576½ feet long, projecting 1,560 feet beyond the adjacent shore line.

The depth of water between piers was 17 feet, with a least depth of 15.9 feet on the bar immediately in front of the entrance, while a channel of approach from the south had a depth of 20 feet.

Expenditures during the last fiscal year were $30,329.32, resulting (1) in an extension of 200 feet to the south pier; (2) the sinking of one crib 50 feet long in extension of the north pier, and the near completion of three more cribs, each 100 feet long, that will soon be sunk for its farther extension; (3) the strengthening and rebuilding above water of 1,631 feet of old pile revetment on the south side, and (4) many scattering repairs on the rest of the older structures.

The depths of water at the close of the year were 17 feet at entrance between piers, 20 feet in southerly channel of approach, 17 feet in the northerly one, and a least depth of 16 feet on the middle ground between them, immediately in front of the harbor entrance.

The formation of the shoal in front of the entrance is the principal difficulty that has to be contended with in the improvement of this harbor. Pier extension alone will not solve the problem. The principal element that contributes to its formation is the sand blown into the harbor from the adjoining uncovered sand dunes, and then carried by the body of water flowing out of Grand River, through the contracted waterway between the piers, until the current is checked on spreading into Lake Michigan and no longer able to uphold its load of sand; it then falls to the lake bed and goes toward the upbuilding of the shoal. The remedy is to cut off the supply of sand by a growth of vegetation on the dunes adjoining the harbor and supplement this with a suitable combination of sand and fences. The estimate for this purpose, submitted in the last annual report, is repeated herein. With this done, and the piers extended as required by the present approved project, a channel depth of full 18 feet at entrance may be counted upon. Nothing less will satisfy the important requirement of making this a safe harbor of refuge. The older pile structures are in need of considerable repairs and much additional filling.

The estimate for 1896 is as follows: For 250 feet of pier extensions, to complete project, $35,000; for rebuilding 667 feet of south pile pier above water, $6,600; refilling pile revetments and incidental repairs to same, $10,000; for sheet-pile revetment north side, 2,500 feet, $15,000; for sand fences and shrub planting to stop drifting of sand into harbor, $7,000; in all, with contingences, $80,000.

July 1, 1893, balance unexpended		$76,165.95
June 30, 1894, amount expended during fiscal year		30,329.32
July 1, 1894, balance unexpended		45,836.63
July 1, 1894, outstanding liabilities	$19,093.31	
July 1, 1894, amount covered by uncompleted contracts	22,220.24	
		41,313.55
July 1, 1894, balance available		4,523.08
Amount appropriated by act of August 17, 1894		25,000.00
Amount available for fiscal year ending June 30, 1895		29,523.08

Amount that can be profitably expended in fiscal year ending June 30, 1896	$80,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix L L 7.)

8. *Muskegon Harbor, Michigan.*—The first improvements at this place were made at local expense, by constructing slab piers and revetments, so as to afford entrance from Lake Michigan to Muskegon Lake for vessels drawing 7 feet. The work was taken in hand by the Government in 1867; old piers were remodeled and extended across the bar at entrance, channel dredged, and a through depth of 12 feet obtained. Thereafter the piers were prolonged as necessitated by the steady lakeward progress of the shore line and sand deposits in advance of it, and a fair 12-foot channel thereby maintained, but the clear way between piers was only 180 feet, making entrance dangerous in stormy weather. After 1882 this difficulty was remedied by building extensions of the north pier on a line 300 feet from the south pier, and connecting the old and new lines by an oblique wing of crib work 330 feet long. In 1892 the project of improvement was amplified and defined, with a view to securing and maintaining a navigable depth of 15 feet; its estimated cost was $260,000. Prior to the adoption of this modified project operations had been carried on under appropriations made from time to time in such sums as were called for to meet immediate necessities, but without defined estimates of ultimate cost. The expenditures for work so done amounted to $262,914.18.

The total of expenditure to June 30, 1893, was $402,461.38, when the north pier and revetment had a completed length of 1,545.6 feet and the south pier 1,182 feet; the available channel depth was 13 feet.

Expenditures during the last fiscal year were $69,097.68. Extensions of the north and south piers, which had been commenced toward the close of the previous year, were thereby completed for lengths of 250.5 and 300.5 feet respectively; 783.3 feet of sheet-pile revetment, commenced during the previous year, were also completed on the north side; making the total increased length of north pier and revetment 1,036.8 feet. The total length of north pier was therefore 2,582.4 feet and of south pier 1,482.5 feet, and they projected beyond the adjoining shore lines 1,220 and 1,280 feet respectively. Some minor repairs were made to old pier work, and dredging to the extent of 36,414 cubic yards was done. The channel depth was full 14 feet, an increase of 1 foot over that available at the beginning of the year.

For obtaining and keeping the proposed depth of 15 feet the piers must be prolonged to the full length called for by the present approved project, which requires extensions of 550 and 500 feet for the north and south piers respectively; the above water work of a section of the north pier 322 feet long, built over twenty-five years ago, is badly dilapidated and must be rebuilt; old piers must receive some minor repairs and considerable additions of stone for filling; the through channel must be dredged to its full width and depth. The sum necessary for these purposes is $150,000, as itemized below, and if it be appropriated the proposed improvement will be accomplished, and maintained for a long period with small annual expenditure for occasional repairs. If the pier extension is deferred, the results gained by recent extension will soon be lost, and large annual expenditures called for to keep such depth of channel as the extensive commerce of this important harbor demands.

The estimate for 1896 is as follows: For 322 feet new superstructure, old north pier, $3,220; refilling piers and revetments, $2,500; minor repairs pier and revetments, $1,500; dredging, $5,000; extending north pier 550 feet and south pier 500 feet, to complete the improvement, $126,000; making, with an allowance of about 8½ per cent for contingencies, a total of $150,000.

July 1, 1893, balance unexpended	$70,636.30
June 30, 1894, amount expended during fiscal year	69,097.68
July 1, 1894, balance unexpended	1,538.62
July 1, 1894, outstanding liabilities	401.53
July 1, 1894, balance available	1,137.09
Amount appropriated by act of August 17, 1894	30,000.00
Amount available for fiscal year ending June 30, 1895	31,137.09
Amount that can be profitably expended in fiscal year ending June 30, 1896	150,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

(See Appendix L L 8.)

9. *White Lake Harbor, Michigan.*—The improvement at this point contemplates the creation and maintenance of a channel 200 feet wide and 12 feet deep between revetments and piers extending to deep water in Lake Michigan, thereby providing easy entrance to White Lake. Before improvement the two lakes were connected by a narrow and winding stream with a navigable capacity of only 5 feet. The estimated cost of the improvement was originally $170,530.80, subsequently increased by additional projects of 1873, 1884, and 1892 to $337,550.

The total expenditure to June 30, 1893, was $272,155.63, and the harbor works then comprised a north pier 1,515 feet long projecting into Lake Michigan 390 feet beyond its shore line, and a south pier 1,854 feet long projecting 730 feet beyond the shore line. The available depth at entrance was 10½ feet. The proposed depth of 12 feet has been obtained from time to time by dredging, but the channel so made soon shoals again to 9 or 10 feet, and this will continue to be the condition of affairs until the piers have been carried to the curve of 15 feet depth in Lake Michigan, now distant about 550 and 250 feet from the ends of the north and south piers respectively.

The amount expended during the last fiscal year was $2,679.[illegible]5, and it was applied mainly to dredging a straight cut 50 feet wide from lake to lake, with a mid-channel depth of 14 feet. The commercial requirements of the harbor were thereby satisfied until the close of the season of navigation, but a survey made May 29, 1894, showed that the channel had again shoaled to 10¾ feet, which was the limit available for navigation at the close of the year.

The estimate for 1896 is intended to provide for extending the piers to the limits at present authorized, but further extensions, aggregating 350 feet, will be required to carry them to the 15-foot curve. Besides this new work there is urgent demand for rebuilding, above water, 367 linear feet of that portion of the old south pier that was built from twenty-two to twenty-four years ago; filling in both piers must be overhauled, and considerable repairs made to the old timber work. Until the piers are extended repeated dredging will be required to meet the needs of navigation. The estimate is as follows: For extending north pier 250 feet and south pier 200 feet, $50,000; for rebuilding 367 linear feet of south pier above water, $3,760; miscellaneous repairs of piers and revetments and dredging, $5,000; making in all, with about 6 per cent for contingencies, $62,000.

July 1, 1893, balance unexpended	$7,394.37
June 30, 1894, amount expended during fiscal year	2,679.45
July 1, 1894, balance unexpended	4,714.92
July 1, 1894, outstanding liabilities	4.30
July 1, 1894, balance available	4,710.62
Amount appropriated by act of August 17, 1894	5,000.00
Amount available for fiscal year ending June 30, 1895	9,710.62
Amount (estimated) required for completion of existing project	53,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	62,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix L L 9.)

10. *Pentwater Harbor, Michigan.*—Originally an unnavigable connection existed between Lake Michigan and Portage Lake, which had been improved by local interests so as to afford a narrow 4-foot channel at the time the Government work was commenced in 1867. The project of improvement then adopted, and followed without modification until the present time, aimed to increase the channel depth to 12 feet, and maintain it between revetments and piers extending into Lake Michigan; its estimated cost was $327,713.40.

The total expenditure to June 30, 1893, was $232,367.27.

The length of north pier and revetment was 2,223 feet and of south pier 2,115 feet, but they reach only to the 10-foot curve in Lake Michigan, and it is therefore impossible as yet to maintain the projected depth of 12 feet between them; this will continue until they are extended to the 14 or 15 foot curve. As matters now are, no matter how deep a channel may be made by dredging, it rapidly shoals to a depth of 9 or 10 feet only.

Expenditures during the past fiscal year amounted to $1,795.11, the principal part of which was for dredging between piers, resulting in a channel 70 feet wide and 16 feet deep. This was done between July 24 and August 22, 1893, but a survey of May 25 and 26, 1894, showed no trace of it left, the best channel then existing between the piers having a depth of 10½ feet only. Besides the dredging the only work done at the harbor during the year was patching up old portions of the piers in the effort to hold them together until means are provided for rebuilding them above water and refilling them with stone. The estimate below is intended to cover the costs of reconstructing these old portions, and of extending the south pier 200 feet. This is the limit of extension authorized at present, but both piers will have to be extended double that amount before a 12-foot channel can be maintained between them, except by constant dredging.

The estimate for 1896 is as follows:

For rebuilding above water and refilling 520 linear feet north pier, $5,210; same for 1,036 feet of south pier, $10,360; dredging $3,000; 200 linear feet new crib work for completing authorized extension of south pier, $24,000, making, with about 6 per cent for contingencies, $45,000.

July 1, 1893, balance unexpended	$6,452.73
June 30, 1894, amount expended during fiscal year	1,795.11
July 1, 1894, balance unexpended	4,657.62
July 1, 1894, outstanding liabilities	350.04
July 1, 1894, balance available	4,307.58
Amount appropriated by act of August 17, 1894	5,000.00
Amount available for fiscal year ending June 30, 1895	9,307.58

Amount that can be profitably expended in fiscal year ending June 30, 1896 $45,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

(See Appendix L L 10.)

11. Ludington Harbor, Michigan.—Before the Government undertook any work for improving this harbor, local enterprise had made a narrow 7-foot channel from Lake Michigan to Pere Marquette Lake, and maintained it for several years. The Government work was commenced in 1867, with the purpose of enlarging the channel to a width of 200 feet, and depth of 20 feet, and protecting it by piers projecting into Lake Michigan; the estimated cost was $270,682. The improvement was duly made, and subsequently maintained by periodical dredging and pier extensions. In 1890 the scope of the design was enlarged, and 18 feet was fixed upon as the depth to be obtained, thereby necessitating extensions of 500 and 700 feet to the north and south piers respectively; it was further designed that these extensions should be so made as to increase the width at entrance to 250 feet. These extensions have been so made, but the full depth of 18 feet has not yet been realized. The total of expenditures on the original and modified projects, to June 30, 1893, was $349,975.01, resulting in a reliable 14½-foot channel, protected between piers aggregating 3,833 feet in length.

The amount spent during the last fiscal year was $5,543.92, applied mainly to dredging and to placing additional stone filling in new cribs. The amount dredged was 13,802 cubic yards, by which the depth of channel was increased to 16 feet.

It is probable that further extension of piers will not be required for some years, but those portions built in the early days of the work are so decayed that they can no longer be held together by ordinary repairs; they must be rebuilt. This and dredging are matters that can not be neglected without serious detriment to the navigable capacity of this important harbor.

The estimate for 1896 is for the following: Rebuilding inner end of north pier, 130 linear feet, $2,600; rebuilding above water 587 linear feet north pier, $5,870; rebuilding above water 1,423 linear feet south pier, $14,230; miscellaneous repairs and stone to provide for settlement of filling in new crib work, $5,000; dredging, $4,000. Making in all, with an allowance of about 10 per cent for contingencies, $35,000.

July 1, 1893, balance unexpended	$7,459.09
June 30, 1894, amount expended during fiscal year	5,543.92
July 1, 1894, balance unexpended	1,915.17
July 1, 1894, outstanding liabilities	1.70
July 1, 1894, balance available	1,913.47
Amount appropriated by act of August 17, 1894	6,000.00
Amount available for fiscal year ending June 30, 1895	7,913.47

Amount that can be profitably expended in fiscal year ending June 30, 1896 35,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

(See Appendix L L 11.)

12. Manistee Harbor, Michigan.—The commerce of this harbor is extensive and continuous throughout the year, its most prominent feature being the regular traffic of the steamers run by the Flint and Pere Marquette Railway Company, the largest of which draws 15 feet when loaded. The number of vessels entered and cleared during the year

1893 was 2,831, with a tonnage of 959,550; the receipts and shipments during the same period were 968,135 tons, the principal items of which were salt and lumber.

Before the Government undertook any work at this place local enterprise had opened an entrance to the river for vessels drawing 7 feet. Systematic work was commenced by the Government in 1867, under a project for pier construction and dredging, with a view to forming and maintaining a navigable channel 12 feet deep at the entrance to and between the piers; the project was extended in 1873 to include dredging in the river for a distance of about 1,350 feet inside the shore end of piers and to constructing revetments along the line of channel so dredged. In 1890 the scope of operations was again extended to include dredging a channel 15 feet deep throughout the length of the Manistee River, a distance of about 8,000 feet, from Lake Michigan to Lake Manistee, and to extending the north and south piers, respectively, to the 18 and 14 foot curves in Lake Michigan, with a view to maintaining that depth of channel at the entrance. The river channel was dredged through in 1891, but soon shoaled again to 13 feet because of the unprotected banks. Congress thereupon made further work in the river to depend upon the construction and maintenance of proper bank protection, and the work now in hand is limited to extending the piers above indicated, keeping them in serviceable condition, and dredging between them.

The amount expended for these improvements up to June 30, 1894, was $345,665.08, of which the sum of $43,554.93 was expended during the last fiscal year.

Operations during the year included the construction of 350 linear feet of crib piers 30 feet wide and from 24 to 26 feet in height, rebuilding 719 feet of old piers from the water surface to 5 feet above, and dredging in channel way between piers.

The north and south piers, with the revetments connected therewith, have at this time lengths of 2,906½ feet and 1,689 feet, respectively, the channel depth between them being not less than 15 feet at any point, as the results of dredging and pier extension made during the past fiscal year. The north pier extension of 350 feet made during the year completes the present project as respects new work on that pier; a like extension of the south pier remains to be done for the completion of that structure. The maintenance of the piers in serviceable condition calls for rebuilding sections that were originally constructed from twenty-two to twenty-five years ago, and estimates for this purpose, as also for extending the south pier and for dredging, are submitted.

July 1, 1893, balance unexpended	$45,889.85
June 30, 1894, amount expended during fiscal year	43,554.93
July 1, 1894, balance unexpended	2,334.92
July 1, 1894, outstanding liabilities	127.61
July 1, 1894, balance available	2,207.31
Amount appropriated by act of August 17, 1894	12,000.00
Amount available for fiscal year ending June 30, 1895	14,207.31
Amount that can be profitably expended in fiscal year ending June 30, 1896 } Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	61,000.00

(See Appendix L L 12.)

13. *Harbor of refuge at Portage Lake, Michigan.*—The great need of a harbor of refuge in this vicinity has long been recognized, and the peculiar adaptability of Portage Lake led to its selection for this purpose as far back as 1878. In 1879 Congress made the first appropriation for the work, but its amount—$10,000—was wholly inadequate for the object in view, and the subsequent appropriations have been insufficient to complete the work. Their expenditure has not produced results of any practical value; the piers have only reached to about half the proposed limits, and are wholly useless as a protection for any channel that may be made between them. The available depth between piers in April, 1894, was only 5½ feet. A channel 40 feet wide and 15 feet deep was dredged April 28 to May 26, to afford relief to the little local commerce, the amount excavated for this purpose being 24,870 cubic yards. In one month's time the dredged channel had shoaled again to an available depth of only 11 feet.

The total expenditure to June 30, 1894, was $98,620.13, of which $1,705.52 was expended during the last fiscal year.

The completion of an easily accessible harbor of refuge at this place is a matter of great importance to the extensive commerce entering and passing the eastern Lake Michigan ports. From Traverse Bay, Michigan, to Michigan City, Ind., the only harbor that may be entered for refuge with comparative safety when shelter is needed is that at Grand Haven, the piers of which are 400 feet apart. The other harbors were not designed for refuge, and their entrances are so contracted that no vessel can attempt them without risk of disaster when the weather conditions are such as to make shelter from the open lake necessary. The fact that these harbors have been improved at great expense to keep pace with the demands of their commerce but magnifies the importance of creating one that will provide shelter for vessels bearing it when approaching their destined ports in heavy weather. In this connection it is proper to note that two schooners attempted to enter Frankfort Harbor, 17 miles distant, on the 31st of October last, missed the entrance, and went on the beach north of the harbor.

The harbor of refuge can not be built with such meager appropriations as have heretofore been made, and it is therefore urged by the officer in charge that the next appropriation be not less than $125,000 if any real effort to make the harbor is to be attempted. If this is not done, it is believed that the work had better be abandoned, as any sum materially less will produce no effective advance toward the end indicated, and there appears to be no good reason for further appropriation with any other object, the local commerce being utterly insignificant. The work proposed, if the above amount is appropriated, includes building 600 linear feet of new crib work for extending the piers, $60,000; rebuilding 1,240 linear feet of wrecked and unserviceable north pier and revetment, $38,000; repairing, sheet-piling, and refilling south pier and revetment, $6,000; dredging, $10,000; making, with an allowance of a little less than 10 per cent for contingencies, the total of $125,000.

As soon as the work above indicated is done, it will be necessary to proceed at once to add 600 linear feet of crib work to the new piers in order to carry them to the 20-foot curve in Lake Michigan, which is the least limit that will suffice to protect a channel between them of such depth and width as is requisite for a harbor of refuge.

July 1, 1893, balance unexpended	$3,885.39
June 30, 1894, amount expended during fiscal year	1,705.52
July 1, 1894, balance unexpended	2,179.87
July 1, 1894, outstanding liabilities	105.27
July 1, 1894, balance available	2,074.60
Amount appropriated by act of August 17, 1894	25,000.00
Amount available for fiscal year ending June 30, 1895	27,074.60
Amount (estimated) required for completion of existing project	142,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	125,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix L L 13.)

14. Frankfort Harbor, Michigan.—Before any work was done by the Government, Lake Aux Becs Scies (Frankfort) could be entered from Lake Michigan by a narrow and uncertain channel, 3 or 4 feet deep. The project adopted on commencing improvements in 1867 was to dredge a new connecting channel 12 feet deep and 200 feet wide, and to protect its sides by pile revetments, and its entrance by crib piers extending 672 feet into Lake Michigan on the north side and 832 feet on the south side. The estimated cost was $146,400. This project was afterwards modified from time to time to provide for repairs, dredging, and necessary pier extension, until that now in progress was adopted in 1892, by which the crib work in north pier will be 1,002 feet long and in south pier 1,250 feet long. The original estimate has thereby grown to $325,659.85 as the total estimated cost of original construction, maintenance, and repairs, and new work included in the present project.

Up to the close of the fiscal year ending June 30, 1894, total expenditure was $273,909.83, of which $3,802.61 was expended during the last fiscal year.

At the beginning of this last year the entrance channel was in good navigable condition, the depth at entrance being 16 feet, made so by dredging under a contract that had been closed in April, 1893.

Operations during the year past were limited to dredging and repairs of the piers. In the work of dredging 6,933 cubic yards was excavated in restoring the channel between piers, and through the shoal that is constantly forming in advance of them because of their insufficient length, this work was completed September 11, 1893, but the storms of early October obliterated that through the shoal, leaving it only 10 feet depth in axis of channel, slightly deeper to the southward, and only 8¼ feet on north pier line. No dredge being available for work there at that time, the large car ferryboats, making regular trips across Lake Michigan to and from the harbor, scoured a new channel by their propeller wheels, and were thereby able to continue their service. The repair work consisted in tearing out portions of old rotted superstructure and replacing it with new; placing 325 linear feet of double sheet piling along the rear face of portions of the north pier, to prevent sand passing through it and filling up the channel between piers; building 365 feet of sand fences, 5 feet high, to check drift of sand over piers into channelway; a large amount of drift timber was cleared out of the piers, and stone filling placed where the supply was deficient.

It is most important that the piers be extended to the limits of the approved project, as entrance to the harbor is liable to complete destruction after every severe storm as long as the present condition of affairs continues. Considerable repairs of piers and additional stone filling are necessary for the security of the old work, and dredging must be resorted to to keep the channel open.

The estimate for 1896 is as follows: 400 linear feet of crib work for extending piers, $40,000; sheet piling, repairing and refilling piers, $5,000; dredging and contingencies, $6,000; total, $51,000.

July 1, 1893, balance unexpended	$7, 831. 13
June 30, 1894, amount expended during fiscal year	3, 802. 61
July 1, 1894, balance unexpended	4, 028. 52
July 1, 1894, outstanding liabilities	420. 77
July 1, 1894, balance available	3, 607. 75
Amount appropriated by act of August 17, 1894	50, 000. 00
Amount available for fiscal year ending June 30, 1895	53, 607. 75
Amount that can be profitably expended in fiscal year ending June 30, 1896 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	51, 000. 00

(See Appendix L L 14.)

15. *Charlevoix Harbor, Michigan.*—The improvements at this place are designed to furnish access to Round and Pine lakes, situated in the northern part of the peninsula between Grand and Little Traverse bays. The original outlet from these lakes to Lake Michigan was a narrow stream through which boats drawing only 2 or 3 feet could pass. Local enterprise improved these conditions by dredging and pier construction so as to permit the passage of vessels drawing 6 feet. Work was then commenced by the Government with an appropriation of $10,000 made in the river and harbor act of August 14, 1876, the project providing for dredging a straight channel 100 feet wide to a navigable depth of 12 feet through Pine River to Round Lake and protecting its sides by pile revetments and its entrance by crib piers 150 feet apart, extending to 12 feet of water in Lake Michigan. This project was extended to provide a revetted channel 12 feet deep from Round to Pine Lake. With this modification the estimated total cost was $186,000.

The amount expended to June 30, 1893, was $102,067.91, when there was a narrow channel 13½ feet deep from Lake Michigan to Round Lake, and one 12½ feet deep from Round Lake to Pine Lake, these depths being the immediate results of dredging during that fiscal year.

The amount expended during the year ending June 30, 1894 was, $6,723.52, and it was applied to restoring the requisite depths of channel by dredging and to repairing piers and revetments. The principal items of repairs were the removal of 400 linear feet of old plank beam revetment and replacing it by a substantial structure of piles and sheet-piling, overhauling stone filling of piers to equalize its distribution, and gathering 63 cords of bowlders from the beach to supply deficiencies in pier filling. The work of dredging has served to maintain the required navigable depth except during a short portion of the year, and the repairs have kept piers and revetments in serviceable condition.

The estimate for 1896 is as follows: 200 linear feet new crib work for extending south pier to 12-foot curve in Lake Michigan, $20,000; removing 500 linear feet of old crib work, north pier, and replacing it by new work, $22,500; dredging and occasional repairs of piers and revetments, $6,000; making in all, with 10 per cent approximately, for contingencies, $53,000.

Concerning this estimate the item of $20,000 for extending south pier is essential to carry its end out to water 12 feet deep, as required by the approved project, and until this is done it will be impossible to keep that depth at entrance. The 500 feet of old crib work that must now be replaced was originally built by local enterprise, and is in imminent danger of destruction by any severe northerly storm, and navigation between the piers would thereby be completely obstructed. It is a waste of money to continue further temporary repairs over this portion. Periodical dredging and minor repairs of piers and revetments are essential for maintaining channels and accessory works.

July 1, 1893, balance unexpended	$10,432.09
June 30, 1894, amount expended during fiscal year	6,723.52
July 1, 1894, balance unexpended	3,708.57
July 1, 1894, outstanding liabilities	868.47
July 1, 1894, balance available	2,840.10
Amount appropriated by act of August 17, 1894	8,000.00
Amount available for fiscal year ending June 30, 1895	10,840.10
Amount (estimated) required for completion of existing project	65,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	53,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

(See Appendix L L 15.)

16. *Petoskey Harbor, Michigan.*—Petoskey lies on the south shore of Little Traverse Bay. Its water front has no sheltered anchorage, and the transfer of a considerable commerce and passenger traffic is effected at a landing pier under conditions of great difficulty and no little danger during the prevalence of high northwest winds. Congress has made two appropriations for improving the condition of affairs.

The river and harbor act of August 17, 1894, contains an appropriation of $10,000 for this improvement, and provides that this amount, with the unexpended appropriations heretofore made for this harbor, is to be expended according to the larger of the two projects submitted in the report of December 21, 1889, of the results of a survey of this locality. The report mentioned is printed in the Annual Report of the Chief of Engineers for 1890, pp. 2673–2675, and the larger project submitted therein proposes the construction of a harbor in the bay by means of a pier projecting offshore from a point westward of the city and connecting with a breakwater extending eastwardly and covering the city front. The sheltered area to be about 12 acres, and the estimated cost of the work is $170,000.

July 1, 1893, balance unexpended	$34,780.80
June 30, 1894, amount expended during fiscal year	4.02
July 1, 1894, balance unexpended	34,776.78
Amount appropriated by act of August 17, 1894	10,000.00
Amount available for fiscal year ending June 30, 1895	44,776.78
Amount (estimated) required for completion of existing project	125,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	125,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

(See Appendix L L 16.)

17. *Cheboygan Harbor, Michigan.*—When survey was made at the mouth of the Cheboygan River in 1870, preparatory to commencing its

improvement in the following year, the navigable channel was only 6 feet deep. The original project of improvement was to dredge an entrance channel 200 feet wide, 14 feet deep, and protect its sides by pile piers and revetments, all at an estimated cost of $395,335. But as actually carried out the feature of side protection has been found unnecessary and therefore omitted; deducting $266,110, which was the proportional part of the total estimate applicable to the omitted feature, leaves $129,225 as the estimated cost of the improvement really undertaken. The dredging was carried to a depth of only 13 feet until 1880, when it was increased to 15 feet for a width of 50 feet in mid-channel. In 1882 it was decided to extend this depth over the full width of channel, and in 1888 to prolong the channel up to the State road bridge. In November, 1889, all the proposed dredging was completed, resulting in a 15-foot channel 200 feet wide, from deep water in the Straits of Mackinac to the State road bridge over the Cheboygan River, a distance of about 7,100 feet. A 40-foot square timber crib, constructed in 1881, marks the entrance to the channel, and constitutes the foundation of a light-house subsequently erected by the United States Light-House Establishment.

The total expenditure for improving this harbor to June 30, 1894, was $129,828.24.

No work has been done there since the close of operations in 1889. In the mean time the 15-foot channel has shoaled to 12 and 13 feet in some places, and its navigable capacity has thereby become materially impaired. It is proposed to restore the full depth of 15 feet, for which purpose there is available an unexpended balance of former appropriations, amounting to $18,171.76. As this will suffice for that purpose, and as there is at this time no approved project for other work, no estimate is submitted for 1896.

July 1, 1893, balance unexpended	$18,197.68
June 30, 1894, amount expended during fiscal year	25.92
July 1, 1894, balance unexpended	18,171.76
July 1, 1894, outstanding liabilities	158.67
July 1, 1894, balance available	18,013.09

(See Appendix L L 17.)

18. *Alpena Harbor* (*Thunder Bay River*), *Michigan.*—The city of Alpena occupies both banks of Thunder Bay River at its mouth, and this reach of river, about a mile long, together with the dredged channel through the bar in advance of it, constitutes Alpena Harbor, which has been the subject of improvements carried on by the Government since 1876, under appropriations for improving Thunder Bay Harbor and Thunder Bay River.

The original depth at entrance to the river was only 7 feet, but local enterprise increased it to 12 feet. The work of improvement by the Government has provided a wider channel and increased the depth to 13, 14, and 16 feet, under successive projects, whose costs were estimated at $4,764, $15,000, and $36,087, respectively; the total of the three separate estimates being $55,851.

The amount expended to the close of the fiscal year ending June 30, 1893, was $34,735.34, at which time a channel 16 feet deep had been made from Thunder Bay to the head of navigation in Thunder Bay River, a total length of about 7,000 feet; that portion in the harbor proper, included between the dock lines established by the city of Alpena, had been completed to its full width, and that in the open cut through the bar at the river's outlet into the bay nearly so.

The amount expended during the last fiscal year was $5,453.83, including $823.63 paid retained percentages due on contract work done toward the close of the preceding year. The work done was dredging, thereby completing the contract and work. The width of finished channel is 200 feet at entrance of cut through the bar, 150 feet at point of entrance between piers, and from that point, conforming to the distance between dock lines established, the width of 100 feet is held for a distance of 2,600 feet, beyond which it is 75 feet for a distance of 1,500 feet, and thence 50 feet to the head of navigation.

The estimate for 1896, submitted below, is for maintaining the navigable capacity of this channel, as it will undoubtedly suffer material deterioration before that time.

Thunder Bay (Alpena) Harbor, Michigan.

July 1, 1893, balance unexpended	$823.63
June 30, 1894, amount expended during fiscal year	823.63

Thunder Bay River (Alpena Harbor), Michigan.

July 1, 1893, balance unexpended	$9,441.03
June 30, 1894, amount expended during fiscal year	4,630.20
July 1, 1894, balance unexpended	4,810.83
July 1, 1894, outstanding liabilities	158.67
July 1, 1894, balance available	4,652.16
Amount appropriated by act of August 17, 1894	4,000.00
Amount available for fiscal year ending June 30, 1895	8,652.16
Amount that can be profitably expended in fiscal year ending June 30, 1896 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	5,000.00

(See Appendix L L 18.)

19. Saginaw River, Michigan.—Before improvement the navigable capacity of this stream was limited by the bar at its mouth, where a channel depth of 8 feet only was available, and by several shoals between there and the city of Saginaw, over which still less depth was to be found. Its improvement was commenced in 1867 by dredging a straight cut through the bar at the mouth to a depth of 13 feet, the work being completed in the following years. In subsequent years the scope of operations was gradually extended to various shoals higher up, but subject to no general project until 1882, when a comprehensive and connected scheme of improvement covering the entire river was proposed and adopted. It called for a navigable channel 14 feet deep and 200 feet wide from Saginaw Bay to the upper limits of Bay City, about 8 miles above the point of beginning, and thence to the head of navigation, some 16 miles farther up, a channel of the same width, but only 12 feet deep. The estimated cost of this project was $446,000, which, added to the estimated cost of the several preceding projects ($294,378), gives $740,378 as the estimate of cost for the whole improvement.

It should be observed that the above estimates concerned the question of original cost only, and took no note of cost of maintenance while the work of construction was in progress; but in a stream of this character that is a matter of great and constant expense, and in the absence of appropriations specifically applicable thereto its cost has of necessity been an annual tax of no small magnitude on the successive appropriations for construction. The sum total of appropriations that will have to be made before the work can be completed must therefore largely exceed the original estimates for construction only.

The total of expenditures to June 30, 1893, was $588,611.89, and the result obtained was a through channel, with depths as proposed, from the bay to near the head of navigation. The channel had its full width of 200 feet in nearly all parts up to include the Bay City front, but above there the width obtained was generally from a quarter to one-half of what it is proposed to make them.

The amount expended during the fiscal year was $66,262.09, most of which was applied to dredging. This work resulted (1) in completing, to its full width, the channel up to Bay City and along its front; (2) in increasing the widths of channels at Melbourne Shoal and New York Works Bar; (3) in restoring the channel at Zilwaukee Bar, where portions of the improved channel had become filled with deposits to such an extent as to obstruct navigation; and (4) in extending the channel along two sections of the river in front of the city of Saginaw, where increased depth was most needed.

Careful surveys were made during the winter of the Zilwaukee Bar, New York Works Bar, Essexville Bar, and bar at mouth of the river. At all these places, except Essexville, the improvements were found very much impaired by deposits, which measured over 85,000 cubic yards in the bar at the mouth.

For reasonable progress on this extensive improvement, and for maintenance of work already accomplished, the sum of $150,000 is needed.

July 1, 1893, balance unexpended	$79,138.11
June 30, 1894, amount expended during fiscal year	66,262.09
July 1, 1894, balance unexpended	12,876.02
July 1, 1894, outstanding liabilities	502.61
July 1, 1894, balance available	12,373.41
Amount appropriated by act of August 17, 1894	40,000.00
Amount available for fiscal year ending June 30, 1895	52,373.41
Amount that can be profitably expended in fiscal year ending June 30, 1896 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	150,000.00

(See Appendix L L 19.)

20. Harbor of refuge at Sand Beach, Lake Huron, Michigan.—The site for this harbor was selected in 1872 after careful consideration. It is on the west shore of Lake Huron, 60 miles north of its outlet into the St. Clair River, and the artificial harbor built there since then is the only safe refuge on that coast from the foot of the lake to Tawas Bay, 115 miles above. The work of construction was commenced in 1873, under a project providing for three sections of breakwater, made of stone-filled crib work, so located as to shelter a water area of some 650 acres and for deepening this area by dredging where necessary. The estimated cost was $1,442,500. The sheltering breakwaters, with a total length of 8,132 feet, were completed in 1885 at a cost of about $975,000, and since that time expenditures have been applied to keeping them in repair, dredging, and supervising the berthing of vessels entering the harbor for refuge.

The total expenditure to June 30, 1893, was $1,133,078.53, and for the fiscal year just closed $43,892.21.

The latter was applied to supervising the use of the harbor, some extensive repairs of the main breakwater, and dredging.

The work of dredging is for the purpose of obtaining a clear depth of 21 feet at the harbor entrances and extending such depth to adjoining portions. These operations are at present designed to cover an area of about 365,000 square yards. The work was done by contract, at a price of 43 cents per cubic yard, making the cost for the year $29,506.17. The material dredged is mainly rock and bowlders.

The repair work comprised rebuilding 330 linear feet of sea wall that had been carried away from the main breakwater during the storm of April 21, 1892; repairing break made by the steamer *Wissahickon*, which, in attempting a landing July 26, ran into the main pier and cut through all the timbers above water; decayed upright facing plank were stripped from the inner face of the breakwater for a length of 4,138 feet, and a new oak fender secured in place along the same length; the old 3-inch decking was removed for a length of 1,424 feet and replaced with 6-inch hemlock plank; all decayed timbers that were accessible were taken out and replaced by new material. The total cost of repairs was $9,680.41. With the funds available it is proposed to continue the work of dredging and general repairs to the above-water section of the breakwaters. But these repairs are superficial, and do not reach to the unseen interior, on which the integrity of the whole structure depends; they but box in the mass and may serve to hold it together for a time, but eventually the steadily decaying interior timbers must give way under the assaults of some storm wave, and with them the whole superstructure, its stone filling, and newly repaired surface. The true policy is to replace such portions by concrete or other masonry, and it is submitted that means should be provided for so doing as occasion offers. The substructure, being below water, does not decay, and may be depended upon as a substantial foundation for the superincumbent masonry. As an initial step in this direction an appropriation of $100,000 is urged, to be applied as breaches occur or such evidence of weakness develops as show imminent danger of collapse. An additional sum of $50,000 is required to continue the work of dredging and provide for expenses of harbor control, miscellaneous repairs of piers and plant, and engineering, superintendence and contingencies. This brings the total estimate for 1896 to $150,000.

As respects the benefits to the general commerce on the Great Lakes, this harbor is second in importance to no other, but its local commercial interests are small. The number of vessels that entered for refuge during the past year was 991, with a total measured tonnage of 384,670; the grand total so entering from 1877 to 1893 inclusive was 20,375; tonnage, 6,451,022.

July 1, 1893, balance unexpended		$180,813.68
June 30, 1894, amount expended during fiscal year		43,892.21
July 1, 1894, balance unexpended		136,921.47
July 1, 1894, outstanding liabilities	$7,235.66	
July 1, 1894, amount covered by uncompleted contracts	30,493.83	
		37,729.49
July 1, 1894, balance available		99,191.98
Amount appropriated by act of August 17, 1894		20,000.00
Amount available for fiscal year ending June 30, 1895		119,191.98
Amount that can be profitably expended in fiscal year ending June 30, 1896 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.		150,000.00

(See Appendix L L 20.)

21. Black River at Port Huron, Michigan.—This stream flows through the city of Port Huron, Mich., and empties into the St. Clair River. Before improvement it had a navigable channel not less than 10 feet deep—except over a few shoals, where the depth was only 8½ feet—for a distance of about 2 miles from the mouth. The river and harbor act of September 19, 1890, appropriated $25,000, "to deepen channel from mouth to Grand Trunk Railway bridge to depth of 16 feet," and a project for making such depth, with channel widths varying from 75 to 160 feet, according to locality, was thereupon prepared and approved; the estimated cost was $75,000. The appropriation was expended in 1891–'92 in excavating within the limits indicated, resulting in a channel of the prescribed depth, with widths of 150 feet, 100 feet, and 50 feet, for distances of about 600 feet, 4,700 feet, and 3,000 feet, respectively. This was the condition of the improvement June 30, 1893, at which date the total expenditures amounted to $24,999.85. Expenditures for the last fiscal year were $9,698.80, which was applied to dredging, and resulted in extending the depth of 16 feet, with a width of 50 feet, to Washington avenue, 1,400 feet above the Grand Trunk bridge, such extension being required by the river and harbor act of July 13, 1892; and the section of river below the bridge, that had previously been dredged to a width of 50 feet, was widened to 75 feet.

Examination of the improvement was made June 19, 1894, which showed a filling of from 3 to 4 feet in the narrow upstream channels and a gradual deterioration of less extent in the wider channels below, except for a distance of about half a mile from the mouth of the river; but this section will be likewise affected in the near future, as the filling process is progressive downstream. It is evident that channels dredged to a width of less than 100 feet will be of little permanence, and if a depth of 16 feet is to be maintained, the narrower channels must be redredged to that width at least. To this end the next appropriation should be not less than $15,000.

July 1, 1893, balance unexpended	$10,000.15
June 30, 1894, amount expended during fiscal year	9,698.80
July 1, 1894, balance unexpended	301.35
July 1, 1894, outstanding liabilities	12.80
July 1, 1894, balance available	288.55
Amount appropriated by act of August 17, 1894	4,000.00
Amount available for fiscal year ending June 30, 1895	4,288.55
Amount (estimated) required for completion of existing project	36,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	15,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix L L 21.)

22. Mouth of Black River, Michigan.—An extensive shoal and a bar formerly existed in the St. Clair River, adjoining the mouth of the Black; the bar lay close to the American side and obstructed approach to the Port Huron docks, while the shoal, forming a "Middle Ground" nearly 50 acres in extent, crowded the main channel in a sharp curve close to the Canadian shore, thereby exposing the vast through commerce of the lakes to the dangers attendant upon passing a narrow and crooked channel with a current of high velocity. In 1871 a project was adopted for dredging the bar and middle ground to a uniform depth of 15 feet, by excavating 257,200 cubic yards, at an estimated cost of $120,660. The work was commenced in 1872 and completed in

1878. A slight shoaling took place in the years following, and the whole area was redredged between 1889 and 1892, the depth of excavation this time being 16 feet, except over a strip bordering the main channel, where it was increased to 18 feet.

The total expenditure to June 30, 1893, was $85,848.58.

No work was done during the past fiscal year, and there is no present need of any; but the shoal is slowly reforming and the draft of lake craft is steadily increasing, so that further dredging will be called for before long. It is important to the entire commerce of the lakes that the channel here be kept in the best possible condition, and the estimate of $10,000, submitted below, is designed to provide means for so doing.

July 1, 1893, balance unexpended	$651.42
June 30, 1894, amount expended during fiscal year	545.32
July 1, 1894, balance unexpended	106.10
July 1, 1894, outstanding liabilities	106.10
Amount appropriated by act of August 17, 1894	4,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	10,000.00

(See Appendix L L 22.)

23. *Clinton River, Michigan.*—This is a navigable stream emptying into Anchor Bay, as the northwesterly part of Lake St. Clair is called, with a natural channel depth of about 10 feet, except at shoals, over which but 5 or 6 feet could be carried before improvement, and a broad flat at the mouth with a general depth of from 3 to 4 feet. In 1870–'71 a channel 9 feet deep, 60 feet wide, and 2,700 feet long was dredged through this flat, but being left without works of protection it soon filled in again. In 1880 a project of general improvement from the mouth to Mount Clemens, 8 miles up stream, was adopted, providing for a through channel 8 feet deep, protected by a pile dike at the mouth, extending across the flat to the curve of 10 feet depth in the bay, and by such revetments at points above as were deemed necessary. The estimated cost, as modified in 1885 and 1889, was $34,564.

The total expenditure on the work from its commencement to June 30, 1893, was $52,735.06, of which $25,500 was applied to occasional and scattering work done prior to the adoption of the present approved project in 1885; the total expenditure applicable to the latter was $27,235.06.

As a result of these expenditures the proposed channel had been obtained by dredging, and kept in a fairly navigable condition by the aid of temporary revetments and occasional redredgings; but the appropriations were at no time sufficient to permit the construction of any protecting works of a permanent character, and the maintenance of the dredged channels, especially of that at the mouth, is wholly impossible, except at the expense of constant dredging, in the absence of such works.

The amount expended during the past fiscal year was $7,311.20 which was applied to building 1,194.5 feet of pile and sheet pile structure for protecting the entrance channel, and to dredging a channel 50 feet wide, 10 feet deep, along the face of this work. The above work was completed in November, 1893.

When the improvement was examined June 19, 1894, the dredged channel and its protecting pile work were found to have suffered no injury, but the river depths above were reduced to 6 and 7 feet on shoals. The light pile structure at the mouth must be greatly strengthened before it can be expected to withstand the drive of ice passing out of Anchor Bay; the fact that it suffered no injury this spring is due to the mild winter preceding, during which there was only a thin formation of ice, which melted away gradually and disappeared without such break-up and movement as generally occurs. A substantial backing of large quantities of rock is necessary for its security.

The money estimated as necessary for completing the project of improvement has been appropriated and expended; and the improvement has been completed in so far as a through channel has been obtained, and kept in fair navigable condition by the aid of frequent dredgings and temporary protecting structures. If the improvement is to be kept up in the future in the same manner as in the past, an appropriation of $10,000 for 1896 will be needed, to be applied to dredging and the renewal of temporary channel protection. If the better and cheaper policy of protecting dredged channels by permanent structures is to be inaugurated, the next appropriation should be not less than $25,000, after which small annual appropriations of from $3,000 to $5,000 will serve to maintain the improvement in good condition.

July 1, 1893, balance unexpended	$7,328.94
June 30, 1894, amount expended during fiscal year	7,311.20
July 1, 1894, balance unexpended	17.74
Amount appropriated by act of August 17, 1894	5,000.00
Amount available for fiscal year ending June 30, 1895	5,017.74
Amount that can be profitably expended in fiscal year ending June 30, 1896 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	25,000.00

(See Appendix L L 23.)

24. Rouge River, Michigan.—Before improvement this stream had a channel depth of from 10 to 17 feet from its mouth, near the southwestern limits of the city of Detroit, for a distance of about 3 miles, and was navigable for light drafts as far as Dearborn, about 15 miles from the mouth. The work of improvement was commenced in 1888, under a project for securing a channel depth of 16 feet with a width of 240 feet for a distance of 800 feet from the mouth and thence with a width of 100 feet to the Wabash Railroad bridge, about 2⅝ miles farther up; the estimated cost was $31,690.39.

The work of improvement was completed in 1892, as projected, with a total expenditure of $30,272.79.

No work was done during the past fiscal year, and the condition of the improvement remains such as to satisfy present requirements of commerce; but it is gradually deteriorating from the effects of deposits, and means should be provided to do such dredging as will be needed to prevent this action from going so far as to obliterate the benefits derived from work already done. For this purpose an estimate of $5,000 is submitted for the year 1896.

July 1, 1893, balance unexpended	$1,417.21
June 30, 1894, amount expended during fiscal year	9.15
July 1, 1894, balance unexpended	1,408.06
Amount appropriated by act of August 17, 1894	5,000.00
Amount available for fiscal year ending June 30, 1895	6,408.06

Amount that can be profitably expended in fiscal year ending June 30, 1896	$5,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

(See Appendix L L 24.)

25. Turning basin in Rouge River, Michigan.—The river and harbor act of September 19, 1890, called for an estimate for "locating and constructing basin in said (Rouge) river, at a point on the same within four miles of its junction with the Detroit River, convenient for the turning and anchoring of vessels." Such estimate was submitted by Col. O. M. Poe, Corps of Engineers, in a report dated December 20, 1890, as follows: Three acres of land for site, at $1,500, $4,500; 74,074 cubic yards excavation at 15 cents, $11,111.10; total, $15,611.10.

The next river and harbor act, approved July 13, 1892, appropriated $5,000 for acquisition of land and beginning construction, according to the foregoing project. The appropriation has been found too small for purchasing the land needed, and accordingly no work has yet been done or expenditure made in relation to the proposed improvement.

When local commerce shall have grown to such extent as to make the facilities of a turning basin more imperative than it is at present, it is probable that the Government will be put to but small expense for the land needed if money should then be available for the prompt completion of the improvement. An appropriation of $10,500 to complete the improvement as projected is therefore recommended for the year 1896.

July 1, 1893, balance unexpended	$5,000.00
July 1, 1894, balance unexpended	5,000.00

Amount that can be profitably expended in fiscal year ending June 30, 1896	10,500.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

(See Appendix L L 25.)

26. Removing sunken vessels or craft obstructing or endangering navigation.—Information of the existence of a wreck in the harbor of Presqu'Ile, Mich., was communicated to this office in the latter part of April, 1894, and instructions were given for its removal. The work was in progress at the close of the fiscal year.

(See Appendix L L 26.)

IMPROVEMENT OF WATERS CONNECTING THE GREAT LAKES.

These works were in the charge of Col. O. M. Poe, Corps of Engineers, having under his immediate orders Lieut. W. L. Sibert and Lieut. Charles S. Riché, Corps of Engineers.

1. Ship channel connecting waters of the Great Lakes between Chicago, Duluth, and Buffalo.—Before improvements were commenced under the project for this work the available depth for navigation in the connecting waters of the Great Lakes was about 16 feet.

The present project, submitted to Congress in pursuance of provisions of the act of September 19, 1890, and adopted by act of July 13, 1892, contemplates the excavation of a ship channel having a navigable depth of 20 feet in the shallows of the connecting waters of the Great Lakes between Chicago, Duluth, and Buffalo, at an estimated cost of $3,340,000.

The work is divided into eight sections, according to locality, and the following channels are to be or have been excavated:

Section 1. A channel 21 feet deep and 300 feet wide at Round Island Shoals, St. Marys River.

Section 2. A channel 21 feet deep and 300 feet wide in Little Mud Lake, St. Marys River, between the lower end of Sugar Island and the lower end of the "Dark Hole."

Section 3. A channel 21 feet deep and 300 feet wide through a reef in St. Marys River, abreast of Sailors Encampment Island.

Section 4. A channel 21 feet deep and 300 feet wide through a shoal in Mud Lake, St. Marys River, 1½ miles below Sailors Encampment Island.

Section 5. A channel 21 feet deep and 2,400 feet wide at the foot of Lake Huron.

Section 6. A channel 20 feet deep from deep water in St. Clair River through St. Clair Flats Canal to deep water in Lake St. Clair, with a width above St. Clair Flats Canal not greater than 650 feet; thence gradually narrowing to the canal; thence for the full width of the canal for its entire length; thence gradually widening to a width of 800 feet at deep water in Lake St. Clair.

Section 7. A channel 20 feet deep and 800 feet wide through Grossepoint Flats, Lake St. Clair, Michigan.

Section 8. A channel 21 feet deep and 800 feet wide through the bar at the mouth of Detroit River.

To obtain a navigable depth of 20 feet, a depth of 21 feet is required where the excavation is through solid rock or through shoals infested with bowlders; a depth of 20 feet where the cut is through soft material.

Contracts for the excavations specified above were entered into December 31, 1892, and if no failure occurs in the appropriations the contract time for the completion of the specified channels is November 30, 1895. Work was begun under contract at the eight localities named during May and June, 1893.

On June 30, 1893, the excavation had not advanced far enough to give any increased depth or width available for navigation.

On June 30, 1894, the area comprised in first section had been dredged to a depth of 21 feet for a width of 300 feet, but has not been cleaned up. On second section the work has progressed faster than the contract calls for, but no increased depth is available for navigation. On third section no increased depth is available and the work is not progressing as fast as contract requires. The fourth section is completed to a depth of 21 feet for a width of 300 feet, and the work accepted. The fifth section has been dredged to a depth of 21 feet for a width of 900 feet. The dredged area has not been cleaned up. The work has progressed faster than contract calls for. Sixth section has been dredged to a depth of 20 feet for the full width of the channel as described in contract, commencing above St. Clair Flats Canal, extending through the canal, and very nearly completed for a distance of 12,000 feet below the canal. The dredging on this section is nearing completion. No cleaning up has been done yet. The work is progressing faster than contract requires. On the seventh section the work is not progressing as fast as contract requires; no increased depth available for navigation. On eighth section the work is not progressing as fast as contract requires; no increased depth available for navigation.

Total expended to June 30, 1893		$23,236.40
Expended during fiscal year ending June 30, 1894, exclusive of outstanding liabilities		362,882.46
Total expended to June 30, 1894		386,118.86
July 1, 1893, balance unexpended		$1,226,763.60
June 30, 1894, amount expended during fiscal year		362,882.46
July 1, 1894, balance unexpended		863,881.14
July 1, 1894, outstanding liabilities	$162,357.35	
July 1, 1894, amount covered by uncompleted contracts	851,804.26	
		1,014,161.61
Amount (estimated) required for completion of existing project		2,090,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896		500,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.		

(See Appendix M M 1.)

2. *Operating and care of St. Marys Falls Canal, Michigan.*—During the fiscal year the canal was open to navigation 235 days. It was closed for the winter December 6, 1893, and on April 17, 1894, was opened for the current season. Thirteen thousand and eleven vessels, etc., aggregating 11,066,168 registered tons and carrying 11,158,992 tons of freight and 20,840 passengers, passed through the lock in 6,065 lockages.

The staple articles transported were 2,372,406 tons of coal, 90,466 tons of copper, 8,281,853 barrels of flour, 34,447.963 bushels of wheat, 2,456,992 bushels of grain other than wheat, 5,085,422 tons of iron ore, 644,521 feet B. M. of lumber, 17,294 tons building stone, and 426,321 tons of miscellaneous or unclassified freight.

The amount expended during the fiscal year ending June 30, 1894, was $55,213.09.

(See Appendix M M 2.)

3. *Saint Marys River at the Falls, Michigan.*—The project for obtaining a navigable channel of 16 feet depth between Lakes Superior and Huron had been barely completed when the demands of commerce so enormously increased that the work of obtaining a depth of 20 feet throughout was undertaken with the full sanction of both legislative and executive authority.

A necessary part of the project is the construction of a new lock upon the site of the old State locks, to have a length of 800 feet between gates, a width of 100 feet throughout, a depth of 21 feet on the miter sills, and a single lift approximating 18 feet. The canal is to be deepened to correspond. The estimated cost of this enlargement of the canal system is $4,738,865, for the details of which see p. 2220 *et seq.* of the Annual Report of the Chief of Engineers for 1887.

The cofferdam surrounding the lock pit is in excellent condition. The pier in front of Fort Brady is completed. The filling behind this pier is completed so far as is necessary at present. The work on the masonry of the lock is completed, except the laying of 128 stone. These stone can not be laid until the anchor boxes for the gates are in position. The anchorages and snubbing hooks are in position. The valves and valve frames have been delivered. Contracts have been entered into for constructing the lock floor, culverts, breast walls, and miter sills; for furnishing and placing in position the turbine power plant; for furnishing and installing the pumping plant; for constructing in place the gates; for the excavations and pier building within the cofferdam; for the foundation for machine house; for building a clay wall between the canal and river; for constructing miter sill valves.

All the above contracts are to be completed prior to December 31, 1894, except the contract for the turbine power plant. The time for the completion of this contract is indefinite and is dependent upon the progress made in constructing the machine house.

The plans and specifications for the machine house are complete, and the work is now being advertised. The designs and specifications for the operating machinery are completed and ready to forward to the Chief of Engineers for approval.

The contract time for completing the deepening of the canal prism has been extended to July 1, 1895. About four-fifths of the area has been dredged over, and a depth of 17 feet (at least) is available for navigation through the north half.

The widening of the channel at the "Elbow," Lake George, St. Marys River, has been completed.

Total expended to June 30, 1893		$1,442,567.80
Expended during fiscal year ending June 30, 1894, exclusive of outstanding liabilities		819,414.87
Total expenditure to June 30, 1894		2,261,982.67
July 1, 1893, balance unexpended		$2,537,458.83
June 30, 1894, amount expended during fiscal year		819,414.87
July 1, 1894, balance unexpended		1,718,043.96
July 1, 1894, outstanding liabilities	$85,562.60	
July 1, 1894, amount covered by uncompleted contracts	769,474.06	
		855,036.66
July 1, 1894, balance available		863,007.30
Amount appropriated by sundry civil act of August 18, 1894		300,000.00
Amount available for fiscal year ending June 30, 1895		1,163,007.30
Amount (estimated) required for completion of existing project		483,865.00
Amount that can be profitably expended in fiscal year ending June 30, 1896		483,865.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.		

(See Appendix M M 3.)

4. Hay Lake Channel, St. Marys River, Michigan.—Before improvements were commenced the channel through Hay Lake was restricted in depth at Sugar Island Rapids and at Middle Neebish. At these two places a maximum draft of but 8 or 9 feet could be carried if a very irregular course were taken, and practically vessels drawing more than 6 feet of water would not attempt the passage. In addition to the places above mentioned there were some shoals in Hay Lake requiring removal to make the channel available for vessels navigating St. Marys River.

The original estimates for this improvement were based upon a project for a channel 300 feet wide and 17 feet deep, leaving the present navigable channel of St. Marys River at Sugar Island Rapids (about 2½ miles below the canal) through these into Hay Lake, and then by the way of Middle Neebish, rejoining the present navigable channel at the foot of Sugar Island, thus saving a distance of 11 miles and obtaining a route which can be so marked by lights as to be navigable by night, a condition impracticable with the present channel, except by the use of many lights. The estimated cost of this project was $2,127,292.

The above project was subsequently modified to increase the navigable depth to 20 feet, the estimated cost being $2,659,115, subject to change, however, in case unexpected difficulties are developed during the progress of the work.

Prior to the beginning of work under the contracts now in force, 611,907.17 cubic yards, bank measure, had been excavated from the channel.

On June 30, 1893, the Hay Lake Channel was not available for the purposes of navigation. Section 1 had been improved to a depth of 20 feet for a width of 300 feet, and work was under way on the five remaining sections, but the entire areas comprised in these sections had not been dredged over, nor was there a continuous channel of increased depth available through these sections.

On June 30, 1894, the entire Hay Lake Channel had been dredged at those places where necessary to a depth of 20 or 21 feet, according to the specifications, for a width of 300 feet throughout, except at one point in Little Rapids, where it is only 250 feet wide for a distance of 800 feet. Sections 1, 3, and 4 had been completed and the work accepted. Some clearing up was necessary on sections 2 and 6, and a small amount of dredging remained to be done on section 5.

This channel has not been formally opened yet, but the steamer *North West* followed by the steamer *J. H. Wade* were passed through the channel without difficulty on June 7. The contracts on sections 2 and 5 have been extended to September 1, 1894, and the contract on section 6 to July 31, 1894. But the channel can be opened at any time for vessels that can pass through the lock of 1881 at St. Marys Falls Canal.

Total expenditures to June 30, 1893		$1,455,163.43
Expended during fiscal year (exclusive of outstanding liabilities)		214,777.01
Total expenditures to June 30, 1894		1,669,940.44
July 1, 1893, balance unexpended		$559,968.22
June 30, 1894, amount expended during fiscal year		214,777.01
July 1, 1894, balance unexpended		345,191.21
July 1, 1894, outstanding liabilities	$41,336.50	
July 1, 1894, amount covered by uncompleted contracts	83,087.00	
		124,423.50
July 1, 1894, balance available		220,767.71
Amount appropriated by sundry civil act of August 18, 1894		150,000.00
Amount available for fiscal year ending June 30, 1895		370,767.71
Amount (estimated) required for completion of existing project		494,115.00
Amount that can be profitably expended in fiscal year ending June 30, 1896		150,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.		

(See Appendix M M 4.)

5. *St. Clair Flats Canal, Michigan.*—The present project for the improvement of the canal contemplates driving a double row of sheet piling to a depth of 26 feet along the channel face of each dike, dredging the area between the dikes to a depth of 20 feet, continuing the channel above and below the canal to the same depth in river and lake, and rebuilding the decayed portions of the timber superstructure. It was considered sufficient to obtain a depth of 18 feet and to postpone obtain-

ing a depth of 20 feet until the general project for a continuous depth of 20 feet along the entire water route shall have reached a more advanced stage. The estimated cost of obtaining these two depths is as follows:

For 18 feet	$365,000.00
For 20 feet	513,559.40

On June 30, 1893, the pile revetment along the channel face of each dike was completed, and a channel 18 feet in depth extended from the 18-foot curve in St. Clair River, about 900 feet above the canal, for the full width of the canal (about 300 feet) and throughout the entire length; thence gradually widening to 380 feet at a distance of 300 feet below the canal; thence with a width of 380 feet a farther distance of 3,300 feet.

No work was done during the fiscal year, and the condition remains as stated in previous paragraph.

That portion of the general project calling for a depth of 20 feet in the canal and approaches has been provided for in the river and harbor act of July 13, 1892, for "ship channel connecting the waters of the Great Lakes between Chicago, Duluth, and Buffalo."

The pile revetment along the channel face of the dikes having been completed, the rebuilding of the decayed portions of the timber superstructure constitutes the work yet to be done.

This timber has been in place some twenty-five years and is in very bad condition.

July 1, 1893, balance unexpended	$4,587.14
June 30, 1894, amount expended during fiscal year	.60
July 1, 1894, balance unexpended	4,586.54

(See Appendix M M 5.)

6. Operating and care of St. Clair Flats Canal, Michigan.—The canal is in the immediate charge of a custodian, who reports any violations of canal regulations, and also acts as inspector whenever work is in progress.

During October, 1893, the damage done to the east and west dikes by the steamers *C. F. Beilman* and *Marina* was repaired. The cost of the work was $233.56.

The damage done to the dikes by storms was repaired by placing 500 cords of cedar bark in the holes washed out. At those places along the dikes where the earth pressure is transmitted through the old work to the new pile revetment, the new pile revetment was tied by means of iron rods passing through the dike to piles in rear of the dike. Twenty-one such rods were placed in the dikes.

During the fiscal year ending June 30, 1894, the ordinary current expenses of operating and care of the canal, such as salary of custodian, trimming willows, etc., exclusive of the amount named above, was $3,358.62.

(See Appendix M M 6.)

7. Grossepoint Channel, Michigan.—Between the lower end of St. Clair Flats and the deep water of Detroit River, the only known obstruction to navigation is the large shoal off Grossepoint, known as Grossepoint Flats. At ordinary stages of water vessels drawing 16 feet can cross this obstruction, but when the water is as low as it has been during the last few years vessels drawing more than 15 feet can pass only with great care and difficulty.

The river and harbor act of August 11, 1888, appropriated $75,000 for "improving St. Clair Flats Ship Canal, * * * all or any portion of which may, in the discretion of the engineer, be expended in dredging Grosse Pointe Channel." The sum of $5,000 was consequently reserved from this appropriation for the removal of any small and well-defined obstruction that might be found at Grossepoint, as well as for making such surveys as might be necessary before making a definite project. A small shoal was removed in July, 1889, but no more such obstructions have since been found.

Grossepoint Channel forms part of the "ship channel connecting the waters of the Great Lakes between Chicago, Duluth, and Buffalo," which is provided for in the river and harbor act of July 13, 1892, and all information and estimates concerning the work at this point will be found in the report for last-named work.

July 1, 1893, balance unexpended	$3,844.05
July 1, 1894, balance unexpended	3,844.05

(See Appendix M M 7.)

8. *Detroit River, Michigan.*—Originally the channel at Lime Kiln Crossing, Detroit River, could not be depended upon for more than 13 feet of water, the ordinary depth being much affected by the direction of the wind. As originally projected in 1874, the improvement at this point was to consist of a curved channel 300 feet wide, with a uniform depth of 20 feet; and the original estimate was based upon this project. In 1883 it was wisely determined to so modify the project as to secure a straight channel, the least width of which should be 300 feet, with a somewhat greater width at each end, utilizing the work already done. In 1886 this was further modified to the end that the width of the channel should be increased to 400 feet by removing an additional 100 feet from the western (American) side; and in 1888 a further additional width of 40 feet on the western side was authorized, as the lowest bid under the final appropriation was so low that the money available was sufficient to pay for the increased excavation.

The 440-foot channel was completed during the fiscal year ending June 30, 1891, at a cost of but little more than half the estimate for the 400-foot channel.

The present project for improving Detroit River contemplates the removal of such shoals between Detroit, Mich., and Lake Erie as obstruct navigation.

No work has been done during the fiscal year. The obstructions found by sweeping in 1893 are a menace to navigation, and since nearly 25,000,000 tons of freight pass through this river each year, these obstructions should be removed, cost what it may.

The ship channel connecting waters of the Great Lakes between Chicago, Duluth, and Buffalo can not be available for vessels drawing more than 16½ feet of water until these obstructions in Detroit River are removed.

The estimate for obtaining a channel 20 feet deep and 800 feet wide from the head of Ballards Reef to the head of Lime Kiln Crossing is $180,000, of which $58,742.66 is available from appropriation made under previous estimate, leaving $121,257.34 to be appropriated, all of which will be required during the fiscal year ending June 30, 1896.

July 1, 1893, balance unexpended	$29,163.20
June 30, 1894, amount expended during fiscal year	420.54
July 1, 1894, balance unexpended	28,742.66
Amount appropriated by act of August 17, 1894	30,000.00
Amount available for fiscal year ending June 30, 1895	58,742.66

Amount (estimated) required for completion of existing project	$121,257.34
Amount that can be profitably expended in fiscal year ending June 30, 1896	121,257.34
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix M M 8.)

INVESTIGATION OF RAFT-TOWING ON THE GREAT LAKES AND THEIR CONNECTING WATERS, IN COMPLIANCE WITH JOINT RESOLUTION APPROVED FEBRUARY 3, 1893.

Under the provisions of joint resolution approved February 3, 1893, a Board, consisting of Col. O. M. Poe, Maj. Charles E. L. B. Davis, and Maj. Clinton B. Sears, Corps of Engineers, was by authority of the Secretary of War constituted by Special Orders No. 7, Headquarters, Corps of Engineers, February 23, 1893, "to investigate the subject of raft-towing on the Great Lakes and their connecting waters, and to report to Congress as to what restrictions, if any, should be placed upon the size and manner of constructing and towing rafts upon said Great Lakes and their connecting waters." The report of the Board upon the subject, with its conclusions and recommendations for legislative action, was rendered November 9, 1893, and transmitted to Congress and printed in House Ex. Doc. No. 22, Fifty-third Congress, second session. A copy of the report is submitted herewith as Appendix M M 9.

IMPROVEMENT OF RIVERS AND HARBORS ON LAKE ERIE WEST OF ERIE, PA.

This district was in the charge of Lieut. Col. Jared A. Smith, Corps of Engineers.

1. *Monroe Harbor, Michigan.*—This harbor is in the Raisin River, about 2½ miles above the mouth of the dredged canal which forms the present outlet into the lake. The mouth is protected by two piers, the one on the north side being of crib work filled with stone and the one on the south side being a construction of piling.

The canal is 4,000 feet long, 100 feet wide, and was dredged to a depth of 10 feet. The sides of the canal are protected by sheet piling, supported by ordinary piles and waling pieces. This improvement was commenced in 1835, and was completed many years ago. Before the improvement was commenced the mouth of the river was at a point about 2 miles south of present piers, and the channel was over a very shallow bar. At present the depth of water exceeds 9 feet over the bar and throughout most of the channel to the wharves.

A project for repairs to piers and canal revetment was adopted in 1886, the cost then being estimated at $20,000. In 1891 the estimate was increased to $26,000.

The amount expended upon the improvement previous to the project for repairs in 1886 was	$213,515.27
The amount expended under the project for repairs to June 30, 1893, including liabilities, was	14,569.83
Amount expended in last fiscal year	9,592.72

Under the appropriation of July 13, 1892, the work of repairs to north pier was undertaken June 5, 1893. The work was continued until September 23, 1893, when it was closed.

During the season the superstructure of north pier was rebuilt throughout its entire length, with the exception of a very few oak timbers near the water level which were found to be sound. Some repairs were also made to the south pier.

The revetment of the canal is in very bad condition and should be repaired, as it is necessary for the preservation of the channel in the canal.

July 1, 1893, balance unexpended	$9,692.72
June 30, 1894, amount expended during fiscal year	9,592.72
July 1, 1894, balance unexpended	100.00
July 1, 1894, outstanding liabilities	15.00
July 1, 1894, balance available	85.00
Amount appropriated by act of August 17, 1894	5,000.00
Amount available for fiscal year ending June 30, 1895	5,085.00
Amount (estimated) required for completion of existing project	11,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	11,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

(See Appendix N N 1.)

2. *Toledo Harbor, Ohio.*—The original project for improving this harbor was adopted in 1866, pursuant to the act of June 23, 1866, appropriating $20,000 for the improvement. The project provided for improving the old channel through Maumee Bay by dredging to a depth of 12 feet and width of 200 feet. This was amended, from time to time, until the old channel had a least depth of 15.5 feet.

In 1887 a project was adopted, in compliance with requirements of previous acts of Congress, for a straight channel through Maumee Bay. The line was so located as to utilize the old channel as far as possible, and was planned for a width of 200 feet and a depth of 17 feet. Owing to the great length the width is insufficient, and the outer section will be widened to 300 feet as soon as practicable. The entire length of straight channel is about 8 miles. It is situated almost on the middle line of Maumee Bay from the mouth of the river to deep water in the lake.

The amount expended on old channel previous to June 30, 1893, was	$724,332.61
Amount expended on straight channel to June 30, 1893, including liabilities	488,892.95

As a result the channel had been practically completed as originally planned, except the protection dikes, and portions of it had been redredged to remove material which had subsequently filled in.

Expenditures incurred in last fiscal year, $98,537.45.

Dredging has been continued under contract, and 351,277 cubic yards of material has been removed from straight channel. The entire channel has a depth of 17 feet in the middle, but has considerably less depth at the edges. Since the first dredging the parts nearest the river show an annual fill of about 6 inches. The part nearest the lake also fills somewhat, but it has been completed more recently, and its condition respecting fill is not so well ascertained.

With a view of maintaining the channel in the cheapest and most efficient manner, a dredge, scows, and tug have been purchased, and they have been employed upon the improvement since early in May, 1894.

The river and harbor act of July 13, 1892, provided that part of the appropriation for Toledo Harbor might be used in removing shoal in old channel and in extending the improvement up the Maumee River.

A survey of the river has been made extending about 4 miles up the river to the second railroad bridge. A shoal in the river having a depth of 14 to 16 feet extends over a distance of nearly 4,000 feet between the W. & L. E. R. R. bridge and the bridge controlled by the Pennsylvania Railroad Company.

A channel 400 feet wide and 18 feet deep is being excavated by the dredge recently purchased. At the end of the fiscal year the dredge had removed 28,102 cubic yards.

For more than a year the straight channel has been navigated by day, but the outer division has not been lighted in such manner as to enable vessels to keep in the channel by night.

July 1, 1893, balance unexpended		$194,972.55
Deposited to credit of appropriation		50.00
		195,022.55
June 30, 1894, amount expended during fiscal year		98,537.45
July 1, 1894, balance unexpended		96,485.10
July 1, 1894, outstanding liabilities	$2,380.97	
July 1, 1894, amount covered by uncompleted contracts	51,740.44	
		54,121.41
July 1, 1894, balance available		42,363.69
Amount appropriated by act of August 17, 1894		70,000.00
Amount available for fiscal year ending June 30, 1895		112,363.69
Amount (estimated) required for completion of existing project		1,130,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896		300,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.		

(See Appendix N N 2.)

3. *Port Clinton Harbor, Ohio.*—An examination of the harbor and a plan of improvement was made in 1870. The channel then was narrow and crooked, with a depth not exceeding 5 feet.

Under the appropriation of July 10, 1872, the improvement was commenced by dredging a channel through the bar at the mouth.

In 1875 a plan was adopted to confine the channel over the bar by piers. It consists of a pile revetment 967 feet long, running from the north shore of Portage River out into the lake in a direction north 57° east, and then in a more northerly direction 301 feet farther, to where a pile dike is commenced and was planned to be extended 1,200 feet to where the ordinary lake depth is but 12 feet.

The east pier was designed to be a simple pile structure about 2,600 feet long, the outer portion being parallel to and 200 feet distant from the west pier, and the inner end reaching the shore of the lake, which at that point is also the south shore of the river at its mouth.

The estimated cost was $122,000, but a cheaper construction was subsequently decided upon and the estimate of cost was reduced to $90,000.

The expenditure from 1872 to June 30, 1893, was $66,175.54.

As a result the east and west piers had been extended to within 420 feet and 480 feet of completion, respectively.

Of the amount of $10,000 appropriated by act of July 13, 1892, $1,200 has been paid to Mr. Charles Roose, of Oak Harbor, Ohio, for a portion of the sand beach in accordance with the terms of the act.

The expenditures of the fiscal year, including liabilities outstanding, have been $9,139.99.

The channel has been dredged to a depth of about 11 feet and 100 feet wide between the piers; the harbor in front of wharves has been dredged 200 feet wide and about 11 feet deep; the bar has been dredged outside, and a large rocky shoal lying in the way of vessels approaching the harbor has been removed. The piers are in bad condition and should be repaired.

The officer in charge recommends that the project be not completed, but that the amount estimated therefor be expended in the necessary repairs.

July 1, 1893, balance unexpended	$9,824.46
June 30, 1894, amount expended during fiscal year	7,428.30
July 1, 1894, balance unexpended	2,396.16
July 1, 1894, outstanding liabilities	1,711.69
July 1, 1894, balance available	684.47
Amount appropriated by act of August 17, 1894	6,000.00
Amount available for fiscal year ending June 30, 1895	6,684.47
Amount (estimated) required for completion of existing project	21,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	21,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix N N 3.)

4. *Sandusky Harbor, Ohio.*—Various improvements to this harbor were made from 1826 to 1879, at a total cost of $222,980. The channel over the bar had but 10 feet depth, and the greatest depth inside was about 12 feet in 1880.

In 1880 a definite project was adopted for a channel 200 feet wide and 15 feet deep through the outer bar and by an indirect route to the city wharves, along the front of which the channel was to be 100 feet wide and 15 feet deep. This work was nearly completed in 1888, when a project was adopted for a straight channel 200 feet wide and 17 feet deep from the east end of the wharf channel to the north end of Cedar Point. The estimated cost of this project was $96,712.

The amount expended upon the channel planned in 1880 was	$57,500.00
Total expended previous to present project	280,480.00
Amount expended on straight channel to June 30, 1893	69,708.53
Amount expended in maintenance of old channels, 1888 to June 30, 1892	13,726.17

The straight channel had been approximately two-thirds dredged, and the estimated amount to complete was 250,000 cubic yards.

Expenditures incurred in last fiscal year, including liabilities outstanding, were $29,343.18.

Work under contract for dredging straight channel was commenced early in July, 1893, and continued through the year, except when suspended for the winter. The amount dredged to June 30, 1894, was 200,093 cubic yards. Dredging will be continued until the channel is completed as planned, which will probably be before the end of August, 1894.

The completion of the straight channel will still leave the channel over the outside bar very narrow, crooked, and insufficiently deep, and the channel along the harbor front but 100 feet wide and 13 to 14 feet deep.

July 1, 1893, balance unexpended		$43,277.30
June 30, 1894, amount expended during fiscal year		22,885.49
July 1, 1894, balance unexpended		20,391.81
July 1, 1894, outstanding liabilities	$6,457.69	
July 1, 1894, amount covered by uncompleted contracts	9,438.70	
		15,896.39
July 1, 1894, balance available		4,495.42
Amount appropriated by act of August 17, 1894		30,000.00
Amount available for fiscal year ending June 30, 1895		34,495.42
Amount that can be profitably expended in fiscal year ending June 30, 1896		100,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.		

(See Appendix N N 4.)

5. *Sandusky River, Ohio.*—In 1880 a project was adopted for opening a channel 100 feet wide and 9 feet deep through the bars between the city of Fremont and the channel in Sandusky Bay. The expense was estimated to be $44,000.

The amount expended on the work to June 30, 1893, was	$23,152.79
Amount expended in last fiscal year, including outstanding liabilities	4,706.25

At the close of the last fiscal year a contract was outstanding for dredging through the long bar at the mouth of the river. The work was completed October 21, 1893, leaving a channel of 10 feet over the bar and nearly 9 feet in the river above. The shallowest part of channel through Sandusky Bay does not exceed 8½ feet.

It will be observed that less than two-thirds of the original estimate has been appropriated and expended in fourteen years.

The commerce of the river is very small and entirely local in its nature. The benefits to navigation and commerce are therefore very small.

July 1, 1893, balance unexpended	$4,847.21
June 30, 1894, amount expended during fiscal year	4,297.14
July 1, 1894, balance unexpended	550.07
July 1, 1894, outstanding liabilities	409.11
July 1, 1894, balance available	140.96
Amount (estimated) required for completion of existing project	16,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix N N 5.)

6. *Huron Harbor, Ohio.*—In 1826 the mouth of the river was closed by a sand bar. Improvements consisting of parallel piers to confine and protect the channel were then undertaken.

The project has been modified and extended from time to time as the demands of commerce required. The latest project, approved in 1890, consists in extending the piers to the contour of 16 feet in the lake with the view of obtaining that depth at the entrance and between the piers.

The total amount appropriated and expended from 1826 to 1889, inclusive, was $123,273.71.

As a result the channel had been recovered from a sand bar, which was sometimes dry, and given a depth of water which was ordinarily as great as 16 feet between piers, about 140 feet apart. The depth outside was, however, generally less unless recently dredged.

Since adoption of present project (1890) the expenditures to June 30, 1893, were	$16,352.97
Expenditures in last fiscal year	13,611.91

As a result, the west pier was extended 120 feet in 1891, and in the last fiscal year the east pier was extended 80 feet and the west pier 40 feet. To extend the piers to 16 feet depth in the lake there remains to be constructed 640 feet extension of east pier and 600 feet extension of west pier.

The original estimate of cost, as revised in 1893, is	$145,000
Amount expended in 1891 and in 1893, in extending piers 240 feet	20,000

Of the amount of $31,000 appropriated by acts of September 19, 1890, and July 13, 1892, the sum of $9,839.88 is chargeable to repairs and dredging, and the small balance remaining is reserved for the same purpose.

The contract for pier extension, 80 feet on east pier and 40 feet on west pier, outstanding at the beginning of fiscal year was satisfactorily completed September 19, 1893.

In the spring of 1894, 289 feet of the superstructure of west pier was entirely rebuilt, and various minor repairs were made. Under the outstanding contract for dredging through the bar, work is to be commenced July 1, 1894.

The apparent increase in amount estimated to complete project is due to correction of an error which is explained in the report of the officer in charge of the improvement.

July 1, 1893, balance unexpended	$14,772.03
June 30, 1894, amount expended during fiscal year	13,611.91
July 1, 1894, balance unexpended	1,160.12
July 1, 1894, outstanding liabilities	16.67
July 1, 1894, balance available	1,143.45
Amount appropriated by act of August 17, 1894	10,000.00
Amount available for fiscal year ending June 30, 1895	11,143.45
Amount (estimated) required for completion of existing project	115,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	50,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix N N 6.)

7. *Vermillion Harbor, Ohio.*—In 1836 there was less than 2 feet of water over the bar at the mouth of the river and a project was adopted to extend parallel piers, 125 feet apart, over the bar into the lake. This was amended from time to time until the piers were extended to a depth of 12 feet in the lake in the spring of 1874. The east pier was then 1,075 feet and the west pier 1,125 feet in length. In the same year a project was adopted to remove rock and other material between the piers and into the lake to afford a depth of 14 feet over a width of 100 feet. This was completed in 1879.

Since that time the channel has varied, but is rarely less than 12 feet. The piers have been repaired from time to time.

The amount expended for construction and repairs from 1836 to completion of the work in 1879 was	$113,701.28
Since that date there have been seven appropriations expended for repairs of an aggregate amount of	15,000.00

The entire amount was expended previous to June 30, 1893.

No further improvements at this place are recommended, but it is considered desirable to maintain the piers by making repairs as needed.

It is therefore recommended that the amount estimated for completion of project be appropriated for the necessary repairs.

Amount appropriated by act of August 17, 1894	$2,000.00
Amount (estimated) required for completion of existing project	4,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	4,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

(See Appendix N N 7.)

8. *Black River Harbor, Ohio.*—Improvements upon this harbor were commenced in 1828 by extending parallel piers or jetties across the bar to protect and confine the channel. Various amendments and additions to the plan have been made from time to time. In 1891 the extension of piers to 17 feet depth in the lake was recommended by the officer in charge of this improvement.

The entire amount appropriated and expended in improving this harbor, from 1828 to 1892, was $232,204.77. As a result the piers had been extended to a depth of about 16 feet in the lake, and the channel ordinarily had a clear depth of 16 feet or more in the middle between piers. It was, however, subject to fluctuations and to the formation of bars outside, so that dredging is needed nearly every year.

As the river and harbor act of July 13, 1892 appropriated an amount in excess of the estimate to extend piers to a depth of 16 feet, the recommendation of the officer in charge of the improvement to extend them to a depth of 17 feet was approved in 1893. The estimated cost was $56,000.

Expenditures upon the last project, including liabilities, to June 30, 1893	$1.800.78

The above was for dredging on the bar and contingent expenses.

Expended in last fiscal year	17,988.96

Work under the contract for repairs and extension of piers was commenced July 10, and completed satisfactorily November 29, 1893. The east and west piers were each extended 40 feet and solid pier heads were built. One hundred and fifty-one and one-half linear feet of the old east pier near the shore was removed and rebuilt entirely new upon a foundation dredged to a depth of 16 feet. Extensive repairs were also made to the west pier.

Of the last appropriation of $20,000, nearly $12,000 have been expended upon repairs and dredging of channel. The details of expenditures are fully explained in the report of the officer in charge of the improvement.

On the 28th of May, 1894, the end of the east pier was badly injured by the collision of a steamer entering the harbor. The owners of the vessel have made satisfactory arrangements to repair the pier at their own expense.

July 1, 1893, balance unexpended	$18,215.89
June 30, 1894, amount expended during fiscal year	17,988.96
July 1, 1894, balance unexpended	226.93
Amount appropriated by act of August 17, 1894	10,000.00
Amount available for fiscal year ending June 30, 1895	10,226.93
Amount (estimated) required for completion of existing project	36,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	36,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

(See Appendix N N 8.)

9. *Cleveland Harbor, Ohio.*—In 1825 the mouth of the Cuyahoga River was obstructed by a long sand bar and the depth of water was but about 3 feet.

A plan of improvement was adopted to straighten the channel at the mouth of the river by constructing parallel piers to confine the current and direct the channel over the bar. The plan was modified and extended from time to time until the piers had reached a depth of 16 feet in the lake, and the channel between them had attained a depth of 15 to 16 feet. This project was completed in 1869.

Subsequent appropriations to 1874 were expended in dredging the channel, and in repairing and rebuilding parts of the piers.

The total expenditure on this improvement, previous to 1875, was $346,881.61.

In 1875, in compliance with an act of Congress, a project was adopted for constructing a harbor of refuge, as the river afforded no anchorage. The project now includes two breakwaters, one west and one east of the channel entrance, the opening between being 500 feet wide. The west breakwater was completed in 1883. The length of the shore arm is 3,130 feet and the part parallel to the shore is 4,030 feet long, a total of 7,160 feet, besides a spur 100 feet long projecting into the lake near the east end. Previous to June 30, 1893, the east breakwater had been extended a distance of 2,043 linear feet, besides a spur 118 feet long projecting into the lake near its west end.

Since adoption of this project in 1875, the expenditure to June 30, 1893, was $1,197,701.61.

About $50,000 of the above amount was expended in maintenance of the old piers and channel.

Amount expended in last fiscal year, $88,117.30.

Work under the contract for extending the breakwater was completed November 9, 1893. The amount of breakwater constructed was 451½ feet.

Dredging under contract was continued until November 15, 1893, resumed March 30, 1894, and completed April 13, 1894. Part of the channel between piers and a large area of the bar between piers and breakwater were dredged to a depth of not less than 18 feet.

The piers are now greatly in need of repairs, and the superstructure of the part of breakwater first built must soon be renewed.

The officer in charge of the improvement recommends a superstructure of concrete.

The area for anchorage is all for which there is any present necessity, so that the extension of the breakwater may be deferred without inconvenience until the part completed is put in a more permanent condition.

July 1, 1893, balance unexpended	$88, 141. 49	
Deposited to credit of appropriation	162. 71	
		$88, 304. 20
June 30, 1894, amount expended during fiscal year		88, 117. 30
July 1, 1894, balance unexpended		186. 90
Amount appropriated by act of August 17, 1894		50, 000. 00
Amount available for fiscal year ending June 30, 1895		50, 186. 90
Amount (estimated) required for completion of existing project		444, 000. 00
Amount that can be profitably expended in fiscal year ending June 30, 1896		200, 000. 00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.		

(See Appendix N N 9.)

10. Fairport Harbor, Ohio.—The harbor of Fairport is near the mouth of the Grand River, Ohio, which is navigable for some distance from the lake.

In 1825 the sand bar across the mouth was so hard and dry in the summer that teams could be driven across. In that year a plan was adopted for improving the harbor by the method of parallel piers to confine and protect the channel. The plans have been modified and extended from time to time until 1890, when the latest project was adopted, providing for extending the parallel piers to a depth of 18 feet in the lake.

The estimated cost, revised in October, 1892, included extending each of the piers 1,060 feet, 2,120 linear feet, at $100 per foot, $212,000.

The cost of dredging and of repairs is not included in the estimate, because the dredging is indefinite and must be repeated from year to year and the repairs are a part of maintenance rather than original cost.

The entire amount expended on the work from 1825, previous to adoption of present project in 1892, was	$319, 503. 08
Amount expended on present project to June 30, 1893, including liabilities	3, 946. 54
Amount expended in last fiscal year	28, 048. 24

At the time the latest project was adopted the channel depth between piers was 16 feet and over the bar 15½ feet.

The pier outside the shore line was in need of some minor repairs, and inside the shore line, especially on the east side, it was and still is in very bad condition.

A special report on the condition of the east pier and its lease and use by a transportation company is included in the report of the officer in charge of the improvement.

Work under contract for extending piers was completed November 30, 1893. The east pier was extended 120 feet and the west pier 160 feet.

Work of dredging through the bar under contract mentioned last year was completed July 7, 1893.

July 1, 1893, balance unexpended	$34, 864. 76
June 30, 1894, amount expended during fiscal year	28, 048. 24
July 1, 1894, balance unexpended	6, 816. 52
Amount appropriated by act of August 17, 1894	20, 000. 00
Amount available for fiscal year ending June 30, 1895	26, 816. 52
Amount (estimated) required for completion of existing project	170, 000. 00
Amount that can be profitably expended in fiscal year ending June 30, 1896	100, 000. 00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

(See Appendix N N 10.)

11. Ashtabula Harbor, Ohio.—In 1826 the natural conditions at the mouth of the Ashtabula River gave but 2 feet depth of water over the bar, and the rock bottom was but 9 feet below the lake surface.

Improvements were then commenced by confining the channel between piers of timber cribs filled with stone. The work has since been repaired, extended, and modified as necessities demanded.

In 1890 and 1891 a plan was adopted to widen the entrance by moving the east pier 45 feet eastward, and to give a greater depth by extending both piers to the depth of 22 feet in the lake, and removing the stone and other material to a depth of 20 feet.

Total expenditures from 1826 to 1891, previous to project for greater width and a depth of 20 feet	$458,734.46
Incurred on present project to June 30, 1893	16,486.75

The result was a channel 168 feet wide between piers with the rock removed to a depth of 17 feet, which was the depth in middle of channel; the sides of channel were ordinarily, more or less, covered by sand and mud, and in freshets or storms bars were liable to form outside the ends of piers. Work on widening harbor was commenced in the spring of 1893.

The expenditures in last fiscal year were $63,216.07.

A part of old east pier 242 feet long has been removed and replaced with new pier 45 feet farther east. To this new pier has been added an extension of 240 feet. The west pier has also been extended 240 feet, making a total of 722 feet of new pier constructed.

The work of rebuilding superstructure of west pier was commenced in April, 1894; a section 282.2 feet long has been rebuilt. This work will be continued as far as it can be done with available funds.

The harbor now has an entrance 213 feet wide and a depth of 17 feet in mid-channel.

July 1, 1893, balance unexpended	$70,053.02
June 30, 1894, amount expended during fiscal year	63,216.07
July 1, 1894, balance unexpended	6,836.95
July 1, 1894, outstanding liabilities	560.50
July 1, 1894, balance available	6,276.45
Amount appropriated by act of August 17, 1894	75,000.00
Amount available for fiscal year ending June 30, 1895	81,276.45

Amount (estimated) required for completion of existing project	180,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	180,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix N N 11.)

12. Conneaut Harbor, Ohio.—The improvement of Conneaut Creek was commenced in 1829, by constructing piers to deepen the water over the bar at the mouth. Appropriations for continuing the improvement were made at irregular intervals until 1875.

The total amount appropriated and expended for construction and maintenance, 1829 to 1875, was $106,629.39.

The channel originally had a depth of only 2 feet. The result of the improvements was a depth of 8 to 9 feet ordinarily, with a maximum depth of 11 feet under favorable conditions.

The works were subsequently allowed to go to decay, owing to the decline of commerce at that place. In 1890 a vessel drawing more than 3 feet could not get over the bar.

The river and harbor act, dated July 13, 1892, appropriated $40,000 under certain conditions for the improvement, which conditions were modified by an act approved February 24, 1893. These points were explained in Annual Report of Chief of Engineers for 1893.

At the end of the last fiscal year a contract was outstanding for constructing an extension of the west pier. Work under the contract was commenced in July, 1893, and completed December 9, 1893. Four hundred linear feet of pier was constructed 24 feet wide; the superstructure is 8 feet above and the bottom of foundation 22 feet below mean lake level. Repairs were made to outer end of old west pier where it was badly exposed and torn away.

The expenditure on this project to June 30, 1893, was	$692.91
Expenditure in year ending June 30, 1894	39,286.15

The Pittsburgh, Shenango and Lake Erie Railroad Company has done a large amount of work in improving and protecting the channel. The channel has been dredged and the old piers have been repaired. The depth of water in the channel is now 17 feet. The railroad company has built about 2,000 front feet of wharf, and has put in 14 hoists for handling iron ore and coal. In a single year since commencing work at the harbor a very large amount of ore and coal has been received and shipped.

From present indications the commerce of this place is developing rapidly.

July 1, 1893, balance unexpended	$39,307.09
June 30, 1894, amount expended during fiscal year	39,286.15
July 1, 1894, balance unexpended	20.94
Amount appropriated by act of August 17, 1894	40,000.00
Amount available for fiscal year ending June 30, 1895	40,020.94
Amount (estimated) required for completion of existing project	420,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	200,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix N N 12.)

13. *Removing sunken vessels or craft obstructing or endangering navigation.*—The schooner *Pelican* was wrecked off Ashtabula Harbor in May, 1893.

The wreck was removed during December, 1893, and January, 1894, at a total cost of $1,490.68.

(See Appendix N N 13.)

IMPROVEMENT OF ERIE HARBOR, PENNSYLVANIA, AND OF RIVERS AND HARBORS IN WESTERN NEW YORK.

This district was in the charge of Maj. E. H. Ruffner, Corps of Engineers; Division Engineer, Col. Henry L. Abbot, Corps of Engineers.

1. *Erie Harbor, Pennsylvania.*—The original survey of this harbor was made in 1819, at which time the channel was narrow and tortuous, with a depth of only 6 feet. In 1823 a plan for the improvement was adopted, and constitutes the present work, excepting some necessary changes. The piers have been extended from time to time, and are now in fairly good condition, excepting the north pier, which needs repairs to the older portions.

The present project contemplated the extension of the piers to the 16-foot curve in the lake and the maintenance of a channel of navigable width 16 feet in depth from the harbor inside to the lake outside. Such a channel, 275 feet wide and not less than 18 feet deep, has been secured, and is now successfully maintained throughout its entire length of 7,150 feet.

The work during the year consisted in the completion of the extension begun during the prior year. That extension was 301.4 feet, and was finished on the 11th of August. Small repairs to existing structures were made and the boathouse was moved.

The total amount expended up to June 30, 1893, was $803,501.80. The amount expended during the fiscal year ending June 30, 1894, was $27,717.47.

July 1, 1893, balance unexpended (including $20,000 reserved for Presque Isle)	$73,082.32
June 30, 1894, amount expended during fiscal year	27,717.47
July 1, 1894, balance unexpended	45,364.85
July 1, 1894, outstanding liabilities	230.00
July 1, 1894, balance available (including $20,000 reserved for Presque Isle)	45,134.85
Amount appropriated by act of August 17, 1894	10,000.00
Amount available for fiscal year ending June 30, 1895	55,134.85
Amount that can be profitably expended in fiscal year ending June 30, 1896 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	25,000.00

(See Appendix O O 1.)

2. *Presque Isle Peninsula, Erie Harbor, Pennsylvania.*—In a report upon the examination of Erie Harbor, made in 1885, it was recommended that the neck of the peninsula be protected by a breakwater, and the movement of sand around the eastern end of the peninsula, which threatens to close the harbor entrance, be arrested by the construction of jetties perpendicular to the shore of the peninsula, at an estimated cost of $173,044.50.

Work under this project was in progress until October, 1889, when it was abandoned, it having been found that the structures built would not stand against the violence of the storms. No further work is at present contemplated, but the sum of $20,000 has been reserved from the appropriation for the improvement of Erie Harbor, to be used, in case of necessity, in closing any breach which may occur.

The total amount expended up to June 30, 1890, was $60,000. Nothing was expended during the fiscal year ending June 30, 1894.

(See Appendix O O 2.)

3. *Dunkirk Harbor, New York.*—The improvement of this harbor was begun in 1827, when the first appropriation therefor was made. The original project was much the same as that of the existing improvement, which comprises the formation of an artificial harbor in front of the city, by means of a breakwater running nearly parallel with the shore, and a shore arm or pier to the westward, with an opening between the piers and the breakwater. By 1832 the sum of $28,439.84 had been expended on the original plan.

Various improvements and repairs were made from time to time, and by 1838 there had been completed 2,125 feet of breakwater and 300 feet of detached breakwater. In 1848 the breakwater was demolished.

Between 1848 and 1870 some portions of the work were renewed and others repaired, and in 1870 a Board of Engineer Officers took into consideration the question of the radical improvement of the harbor. The Board recommended a plan which provided a breakwater 2,860 feet long, one part of which, 2,300 feet in length, was to be nearly parallel with the shore, the other part, 560 feet long, was to be nearly parallel to the axis of the channel entrance.

A channel was to be dredged to secure a depth of 13 feet and a width of 170. Of the 2,300-foot section 1,591 feet has been finished. None of the 560-foot section has been built.

Work during the year consisted in the building of an extension of 250 feet to the breakwater. This was finished November 2, 1893. The breakwater is now in good condition for its present length. The channel has been dredged, under contract, for its entire length of about 2,800 feet, and throughout its full width to the required depth of 13 feet.

The pier has its full length and is in a reasonably good condition. The total amount expended up to June 30, 1893, was $510,361.98. The amount expended during the fiscal year ending June 30, 1894, was $19,095.99.

July 1, 1893, balance unexpended	$23,717.40
June 30, 1894, amount expended during fiscal year	19,095.99
July 1, 1894, balance unexpended	4,621.41
July 1, 1894, outstanding liabilities	3,198.92
July 1, 1894, balance available	1,422.49
Amount appropriated by act of August 17, 1894	20,000.00
Amount available for fiscal year ending June 30, 1895	21,422.49
Amount (estimated) required for completion of existing project	108,116.41
Amount that can be profitably expended in fiscal year ending June 30, 1896	108,116.41

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

(See Appendix O O 3.)

4. *Buffalo Harbor, New York.*—The original project for the improvement of this harbor was adopted in 1826, and provided at first for the construction of piers on the north and south sides of Buffalo Creek. Subsequently a masonry sea wall running south from the shore end of the south pier was proposed and built. In 1868 a detached breakwater, about 2,500 feet lakeward from the light-house, to extend south a distance of 4,000 feet, was proposed and adopted. In 1874 it was determined to extend this breakwater to a total length of 7,600 feet. This breakwater has now its full proposed length, the final extension of 806 feet having been built in 1893. It runs parallel to the shore and about half a mile distant from it. In 1874 it was also proposed to build a shore arm to the breakwater, the inshore end to consist of pile work near shore and crib work in the deeper water. Upon reaching the 16-foot contour line in the lake this shore arm was planned to continue in a direction making an angle of about 45 degrees with the shore and to overlap the south end of the breakwater, leaving an opening of 150 feet. This shore arm would be about 4,100 feet long. During the past year the construction of 1,600 feet of the outer end of the shore arm was in progress under two contracts of 800 feet each. The outer part was practically completed, when a storm on October 14 and 15, 1893, completely wrecked it, and also 350 feet of cribs belonging to the second contract next toward the shore. This second contract had only been carried to the extent of the sinking of seven cribs. The entire 1,150 feet of the shore arm built in whole or in part is sunk through the crust of the lake bed down into soft material below, and so complete is the wreck, that no attempt has been made to repair it. The project will probably be entirely revised, particularly as to the method of construction. Minor repairs have been made during the year to the old portions of the breakwater and to the south pier. A new survey of the harbor and its vicinity is in progress.

The total amount expended up to June 30, 1893, not including outstanding liabilities, was $2,469,799.69. The amount expended during the fiscal year ending June 30, 1894, was $247,604.64.

July 1, 1893, balance unexpended	$321,871.37
June 30, 1894, amount expended during fiscal year	247,604.64
July 1, 1894, balance unexpended	74,266.73
July 1, 1894, outstanding liabilities	1,050.00
July 1, 1894, balance available	73,216.73
Amount appropriated by act of August 17, 1894	70,000.00
Amount available for fiscal year ending June 30, 1895	143,216.73

Amount (estimated) required for completion of existing project	$81,223.17
Amount that can be profitably expended in fiscal year ending June 30, 1896	81,223.17
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix O O 4.)

5. *Tonawanda Harbor and Niagara River, New York.*—The project for this work contemplates a channel 18 feet deep and 400 feet wide from the entrance to the Niagara River at Lake Erie to the north end of Tonawanda Harbor, New York. The work of the year has consisted of dredging to the full width of 400 feet and a depth of 16 feet the channel at the Strawberry Island bar. A careful and exact survey was made of this area. The dredging operations at the Horseshoe Reef channel have been continued throughout the year, when practicable. The main central shoal is finally practically removed. The western shoal is perhaps one-fourth dredged and almost entirely blasted over, practically completing the work of the drill in this vicinity. There will be only limited areas or single spots to remove after the month of July. The amount expended up to June 30, 1893, not including outstanding liabilities, was $176,736.51. The amount expended during the fiscal year ending June 30, 1894, was $45,853.32.

July 1, 1893, balance unexpended		$73,263.49
June 30, 1894, amount expended during fiscal year		45,853.32
July 1, 1894, balance unexpended		27,410.17
July 1, 1894, outstanding liabilities	$6,953.00	
July 1, 1894, amount covered by uncompleted contracts	18,492.00	
		25,445.00
July 1, 1894, balance available		1,965.17
Amount appropriated by act of August 17, 1894		50,000.00
Amount available for fiscal year ending June 30, 1895		51,965.17

Amount (estimated) required for completion of existing project	958,090.16
Amount that can be profitably expended in fiscal year ending June 30, 1896	200,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix O O 5.)

6. *Niagara River from Tonawanda to Port Day (Niagara Falls), N. Y.*—Under provisions of act of September 19, 1890, a survey of this locality was made by Maj. Amos Stickney, Corps of Engineers; and his report thereon of December 31, 1891, with project for improvement, was submitted to Congress and printed as House Ex. Doc. No. 67, Fifty-second Congress, first session (reprinted as Appendix N N 9, Annual Report, Chief of Engineers, 1892). This project contemplated the formation of a channel 300 feet wide from Tonawanda down to Conners Island, 200 feet wide from Conners Island to Grass Island, and increasing from 200 to 400 feet wide from Grass Island to Port Day; and construction of an embankment, from rock excavated from the channel, extending from Conners Island to Port Day, so as to inclose the lower end of the channel. A channel of 12 feet depth was proposed, although it was incidentally estimated that a channel of 8 feet depth could be first provided, which could be enlarged as an increase of commerce might demand. The cost of the proposed channel, 8 feet deep at mean lake level (6 feet at low lake level), was estimated at $257,829.

The river and harbor act approved July 13, 1892, appropriated $20,000 for the commencement of work upon the 8-foot channel.

During the season of 1892 the practicability of constant navigation of Niagara River by vessels of upward of 6 feet draft to the harbor back of Conners Island, which is within easy land communication with Port

Day, was demonstrated. These commercial developments showed that adherence to the project approved by Congress would be inexpedient and would accomplish no results useful to navigation, and that a modification of the project would be desirable, looking to the excavation of a channel 12 feet deep down to Conners Island, and omitting the work proposed below that point to Port Day. For these reasons expenditure of the appropriation of July 13, 1892, has, under the authority of the Secretary of War, been suspended until further action in the matter may be taken by Congress.

July 1, 1893, balance unexpended	$20,000.00
July 1, 1894, balance unexpended	20,000.00
Amount appropriated by act of August 17, 1894	10,000.00
Amount available for fiscal year ending June 30, 1895	30,000.00

(See Appendix O O 6.)

7. *Wilson Harbor, New York.*—The project for the improvement of this harbor was adopted in 1873 and modified in 1877, the object being to afford a channel of navigable width and 12 feet in depth by the extension of parallel piers from the mouth of Twelve Mile Creek to the 12 foot curve in Lake Ontario, with the formation of a protected channel between the piers. The mouth of the creek was originally obstructed by a bar upon which there was a depth of 1 foot. Before the commencement of operations by the United States the piers had been carried about 400 feet into the lake by private enterprise. There is now a channel with only 8.5 depth, and the piers need much repairs. The total amount expended to June 30, 1894, was $64,978.51.

July 1, 1893, balance unexpended	$21.49
July 1, 1894, balance unexpended	21.49
Amount (estimated) required for completion of existing project	13,978.49
Amount that can be profitably expended in fiscal year ending June 30, 1896	29,091.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix O O 7.)

8. *Olcott Harbor, New York.*—The project for the improvement for this harbor was adopted in 1866. It proposes to connect the deep water in Lake Ontario with the deep water in Eighteen Mile Creek, by the extension of two parallel piers from the mouth of the creek to the 11-foot curve in the lake, with the addition of a dredged channel between the piers. The project was modified in 1874 and in 1881 to provide for the removal of rock found in the channel between the piers and for additional pier extension. The natural channel between the mouth of the creek and the lake was obstructed by a bar, upon which there was a depth of 1½ feet. The final project, adopted June 18, 1891, definitely fixes the length of the piers at 850 and 873 feet, respectively, and provides for a channel 180 feet wide, between the piers, decreasing in width to 98 feet at the Main street bridge crossing Eighteen Mile Creek, with a depth of 13.5 feet at mean lake level.

There was no work done during the year. The total amount expended up to June 30, 1893, was $157,563.77. The amount expended during the fiscal year ending June 30, 1894, was $60.

July 1, 1893, balance unexpended	$5,436.23
June 30, 1894, amount expended during fiscal year	60.00
July 1, 1894, balance unexpended	5,376.23
July 1, 1894, outstanding liabilities	16.00
July 1, 1894, balance available	5,360.23

(See Appendix O O 8.)

9. *Oak Orchard Harbor, New York.*—The earliest project for the improvement of this harbor was adopted in 1836, the date of the first appropriation, and proposed the construction of an east and west breakwater, approaching to within 200 feet of each other, and connecting at the opening with two parallel piers extending into the lake.

Subsequent modifications were extensions to the original project to provide for removal of rock and to adjust the harbor to the increased demand of commerce. The present project was adopted in 1881, the object being to extend the piers to the 12-foot curve in the lake, with the formation of a channel of navigable width and 12 feet deep at low water between the piers. The natural entrance into Oak Orchard Creek was narrow, with a depth of 2 to 4 feet.

A shore protection 91 feet long was built in 1888 to the east of the east pier.

The total amount expended up to June 30, 1893, was $204,507.66.

The amount expended during the fiscal year ending June 30, 1894, was $30.

July 1, 1893, balance unexpended	$492.34
June 30, 1894, amount expended during fiscal year	30.00
July 1, 1894, balance unexpended	462.34
July 1, 1894, outstanding liabilities	8.00
July 1, 1894, balance available	454.34

(See Appendix O O 9.)

IMPROVEMENT OF HARBORS ON LAKE ONTARIO EAST OF OAK ORCHARD, N. Y.

This district was in the charge of Capt. Dan C. Kingman, Corps of Engineers; Division Engineer, Col. Henry L. Abbot, Corps of Engineers.

1. *Harbor at Charlotte, N. Y.*—The original project for the improvement of this harbor, adopted in 1829, proposed to connect the deep water in the Genesee River with the deep water in the lake by parallel piers or jetties about 480 feet apart. The present project, adopted in 1881, is to extend the jetties to the 15-foot curve in the lake, and to dredge a channel between them of navigable width and 15 feet depth at low water. The natural channel was tortuous, and in calm weather would, at ordinary stages of the lake, admit vessels drawing 8 feet.

The total amount expended from 1828 to June 30, 1894, is $491,841.58.

The amount expended from the adoption of the present project in 1881 to June 30, 1894, is $173,763.26.

This expenditure has resulted in the construction of 7,057 linear feet of jetty work, of which 4,975 feet is now valuable and necessary to the maintenance of the harbor. The rest of it has been absorbed by the advance of the shore line, and further repairs to it will probably not be necessary.

Five thousand feet of jetty, in round numbers, therefore must be kept in good order. This work is of timber filled with stone. The portion of it that is above water is subject to decay. Its useful life is from twelve to fifteen years. It must then be renewed. The cost of renewal here is about $11 a running foot. There is now 606 feet that is more than eleven years old. It needs renewal, and will cost $6,666. This sum is not included in the amount required to complete the existing project.

The channel between the jetties has been dredged to a depth of 15 feet at extreme low water in the lake for a width of 380 feet. A recent examination shows that this work is not permanent, the current of the river not being sufficient to maintain this depth. Choice will have to be made between periodical dredging and some form of channel contraction.

This expenditure has also sufficed for the protection, preservation, and repair of the existing works, and the renewal of the perishable portions from the beginning of the improvement in 1829 to the present time.

During the past year the west jetty has been extended 365 feet.

July 1, 1893, balance unexpended	$12,793.93
June 30, 1894, amount expended during fiscal year	10,162.29
July 1, 1894, balance unexpended	2,631.64
Amount appropriated by act of August 17, 1894	15,000.00
Amount available for fiscal year ending June 30, 1895	17,631.64
Amount (estimated) required for completion of existing project	94,650.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	75,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix P P 1.)

2. *Pultneyville Harbor, New York.*—The project for the improvement of this harbor was adopted in 1870 (the date of the first appropriation), and proposed the construction of a timber breakwater running eastward from the west shore, and then northward as a jetty into the lake, also an east jetty parallel to and about 200 feet from the west one, and a dredged channel between them.

The project was modified in 1875 to provide for increased dredging. The object of the improvement was to provide a channel of navigable width and not less than 10 feet deep through the bar and into the mouth of Salmon Creek, which was the harbor. The natural channel was not much more than 2 feet deep.

In 1884 it was proposed, in order to make the dredging of permanent value and effect, to build a sand-tight structure parallel to the breakwater and about 100 feet from it, between it and the beach, so as to arrest the movement of the beach sand and keep it out of the channel.

The total amount expended to June 30, 1893, is $73,973.33, and has resulted in the extension of the jetties to the 10-foot curve in the lake, and in the construction of about 200 feet of sand-tight bulkhead, and in a large amount of dredging in the channel. The last work of this kind was done by the United States dredging plant belonging to this district during the month of May, 1893. Ten thousand seven hundred and six cubic yards of material was removed, forming a good channel from the lake between the piers and up the creek as far as the wharves and warehouses. This channel has a general depth of about 10 feet at low water in the lake.

The depth diminishes somewhat in the extreme inner portions of the harbor on account of the rock bottom.

A recent survey shows that the sand-tight bulkhead, in its unfinished condition, is not long enough to keep the channel open.

There is some shoaling beyond the end of it. It should be extended to the full length called for by the project. This expenditure has resulted in the construction of 1,460 linear feet of pier and jetty work, all of which is now valuable and necessary to the maintenance of the harbor. This work is of timber filled with stone. The portion of it that is above water is subject to decay. Its useful life is from 12 to 15 years. It must then be renewed. The cost of renewal here is about $11 a running foot. All of it is now more than 11 years old, and most of it is over 20 years old. It needs renewal and will cost $15,000. This sum is not included in the amount required to complete the existing project.

July 1, 1893, balance unexpended	$62.91
June 30, 1894, amount expended during fiscal year	38.24
July 1, 1894, balance unexpended	24.67
Amount appropriated by act of August 17, 1894	1,500.00
Amount available for fiscal year ending June 30, 1895	1,524.67
Amount (estimated) required for completion of existing project	7,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	7,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix P P 2.)

3. *Harbor at Great Sodus Bay, New York.*—The earliest project for the improvement of this harbor, adopted in 1828, proposed the construction at the mouth of the bay of breakwaters from the east and west shores, approaching to within 500 feet of each other and connected at the opening with parallel jetties extending into the lake.

The subsequent modifications were simply extensions of the original project to adjust it to the increased demands of commerce. The present project was adopted in 1882, the object being to extend the jetties to the 15-foot curve in the lake, and to dredge a channel between them not less than 15 feet deep at extreme low water. The natural channel at ordinary stages would admit vessels drawing 8 feet.

The total amount expended from 1829 to June 30, 1893, is $452,646.80.

The amount expended from 1881 to June 30, 1894, is $80,823.01.

The total expenditure has resulted in the construction of a timber breakwater 3,851 feet in length, and of two jetties 1,580 feet and 1,294 feet in length, the west one extending to the 15-foot curve in the lake, and the east one to the 10-foot curve.

It has also served for the protection, preservation, and repair of these works from 1829 to the present time, and for dredging from time to time, which has served to maintain a channel of navigable width between the jetties which has varied at different times from 8 to 15 feet in depth at low water.

The present available depth is not less than 13 feet at low water. There are now 6,800 linear feet of jetties and breakwaters at this place that are valuable and necessary to the maintenance of the harbor. The remainder has been absorbed by the advance of the shore line. This work must be kept in repair. As it is built of timber and filled with stone, the part above water is subject to decay. Its life is from 12 to 15 years. The cost of renewing the superstructure of the kind used here is about $11 a running foot. There are now 1,426 feet of it that are from 11 to 16 years old. It needs renewal and will cost $16,000. This sum is not included in the amount given as required to complete the existing project.

July 1, 1893, balance unexpended	$3,610.39
June 30, 1894, amount expended during fiscal year	3,578.40
July 1, 1894, balance unexpended	31.99
Amount appropriated by act of August 17, 1894	15,000.00
Amount available for fiscal year ending June 30, 1895	15,031.99

Amount (estimated) required for completion of existing project	$28,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	28,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix P P 3.)

4. *Harbor at Little Sodus Bay, New York.*—The first project for the improvement of this harbor was adopted in 1829 and has since been variously modified.

The first appropriation was made in 1852. The first project proposed to partially close the opening between the bay and the lake by lateral dikes connected with two parallel jetties extending into the lake.

The present project, which is simply an expansion of the earlier ones, was adopted in 1881 and is designed to afford a channel of navigable width and not less than 15 feet deep at low water by extending the jetties and dredging between them. The original entrance into the bay had a depth of about 1¼ feet at extreme low water.

The total amount expended from the date of the first appropriation in 1852 to June 30, 1894, is $316,818.61.

The amount expended from the adoption of the present project in 1881 to June 30, 1894, is $82,377.84.

The total expenditure has resulted in the construction of 5,989 feet of dikes and jetties, which completes the dike work and extends the jetties to the 12-foot curve in the lake. It has also served for the protection, preservation, and repair of these works from the time they were built to the present time.

A narrow channel 15 feet deep has been dredged through the hardpan bar across the entrance to the channel.

Of the dike and jetty work some 4,900 linear feet is still valuable and necessary to the maintenance of the harbor. The rest has been absorbed by the advance of the shore line.

This work is built of timber and filled with stone. The part that is above water is subject to decay. Its useful life is from 12 to 15 years. It must then be renewed. The cost of renewal here is about $11 a running foot. There is now 1,692 feet of it that is from 11 to 16 years old. It needs to be renewed and will cost $19,000.

This sum is not included in the amount given as required to complete the existing project.

July 1, 1893, balance unexpended	$6,430.35
June 30, 1894, amount expended during fiscal year	6,308.19
July 1, 1894, balance unexpended	122.16
Amount appropriated by act of August 17, 1894	8,000.00
Amount available for fiscal year ending June 30, 1895	8,122.16
Amount (estimated) required for completion of existing project	44,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	40,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix P P 4.)

5. *Oswego Harbor, New York.*—The earliest project for the improvement of this harbor was adopted in 1827, and proposed to inclose an area at the mouth of the Oswego River by extending jetties from the shore into the lake, joining the outer ends by a breakwater, and leaving an opening through which to enter the harbor.

This project was completed in 1869, and forms the present inner harbor.

The present project was adopted in 1870, and consists of a breakwater 5,800 feet in length, generally parallel to the old west breakwater, and 1,100 feet in advance of it. The estimated cost was $1,161,682. This estimate, of course, did not include its subsequent repairs and maintenance. This project was afterward modified by the proposed construction of an east breakwater 2,700 feet in length; the reduction to 350 feet of the opening between the east end of the west breakwater and the north end of the light-house pier; the construction of spurs along the face of the outer west breakwater to reduce the effect of accumulated seas, and to provide for deepening by dredging the inner harbor at the mouth of the Oswego River.

The act of Congress of August 11, 1888, provided for the removal of the outer east breakwater, of which 250 feet had been built.

This has been done, and the construction of an east breakwater now forms no part of the project.

In 1890 the project was further modified by providing for the protection and permanent maintenance of an opening that had been formed by waves in a storm through the outer breakwater near the western angle, the object of this opening being to keep the water in the harbor pure by allowing a circulation through it, and to provide another entrance for small vessels.

The natural entrance to the mouth of the river was shallow and difficult of access, and afforded very little shelter to vessels of any considerable size.

The sundry civil act approved March 3, 1893, authorized the unexpended balance of the current appropriation to be applied to the removal A rock within the harbor lines to a uniform depth.

A project was therefore prepared for the removal of about 3,000 cubic yards of solid rock from the bed of the river near its mouth, so as to secure a uniform depth of 15 feet at extreme low water in this portion of the harbor. This project was completed during the present year by the removal of 3,170 cubic yards, at a cost of $8,957.50.

The improvement has been very beneficial to the harbor, and has given a marked impetus to its commerce.

The object of all these improvements has been to give protection and shelter to the city docks and wharves and to the commerce of the harbor, and to make a depth suitable for the deepest draft vessels on the lake.

The total amount expended since the adoption of the first project in 1827 is $1,800,108.12.

The amount expended from the adoption of the present project in 1870 is $1,326,727.42.

The total expenditure has resulted in the completion of the original project of 1827 and in the construction of the outer west breakwater; the reduction to 350 feet of the opening between the east end of this breakwater and the north end of the light-house pier; the construction and removal of about 250 feet of the east breakwater; the completion of two spur cribs, and the deepening of the river mouth to a depth of 15 feet at low water; in the securing of full protection to the dock and wharves west of the river mouth, and channels of entrance 16 feet deep and 350 feet wide to the inner and outer harbors, and in securing increased depth in the inner harbor.

In addition, the various works have been cared for and maintained and the perishable portions renewed, when necessary, from the beginning of the work in 1829 to the present time.

The operations of the fiscal year have been the rock excavation before described and certain necessary repairs to the breakwater and the plant belonging to the work.

The outer breakwater suffered a serious injury from storms during the past winter. Fortunately the injuries are confined to a single place, just west of the second spur crib.

The breakwater is practically breached at this point for a length of 35 feet. It will have to be rebuilt here from the foundation up. The estimated cost is $10,000.

There has been constructed here 8,776 linear feet of piers and breakwaters, of which 6,465 feet is valuable and necessary to the maintenance of the harbor. The rest has been superseded by the later works.

It is all built of timber and filled with stone. The part above water is subject to decay. Its useful life is from 12 to 15 years.

The superstructure required here is very expensive owing to its exposure. It cost about $40 a running foot.

There is now 3,716 feet of it here that is from 11 to 16 years old. It needs to be renewed, and will cost $150,000.

This sum is not included in the amount given as required to complete the existing project.

July 1, 1893, balance unexpended	$18,818.12
June 30, 1894, amount expended during fiscal year	13,295.54
July 1, 1894, balance unexpended	5,522.58
July 1, 1894, outstanding liabilities	120.12
July 1, 1894, balance available	5,402.46
Amount appropriated by act of August 17, 1894	37,000.00
Amount available for fiscal year ending June 30, 1895	42,402.46
Amount (estimated) required for completion of existing project	58,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	58,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix P P 5.)

6. *Harbor at Sacketts Harbor, N. Y.*—The project for the improvement of this harbor was adopted in 1881, and proposed the deepening of the harbor by dredging over an area of about 15 acres to a depth of 12 feet at low water. The depth previously existing was less than 8 feet over a large part of this area.

In 1826 and 1828 the sum of $6,000 was expended in clearing and deepening this harbor. The total amount expended from 1826 to June 30, 1894, is $14,682.26.

The amount expended from the adoption of the present project to June 30, 1894, is $8,682.26, and has resulted in the removal of 24,010 cubic yards of sand, mud, and gravel from the harbor, and in the construction of a stake and fascine dike 164 feet in length, with a mooring crib 18 feet square at its extremity to shelter the basin and exclude gravel drift from it. With the completion of this work the harbor has a depth of 12 feet at low water over about 6 acres of its area, except in a small place where the presence of rock in place limited the depth to a little less than 12 feet.

July 1, 1893, balance unexpended	$411.26
June 30, 1894, amount expended during fiscal year	93.52
July 1, 1894, balance unexpended	317.74
Amount appropriated by act of August 17, 1894	5,000.00
Amount available for fiscal year ending June 30, 1895	5,317.74

(See Appendix P P 6.)

IMPROVEMENT OF RIVERS AND HARBORS IN VERMONT AND NORTHERN NEW YORK.

This district was in the charge of Capt. Smith S. Leach, Corps of Engineers; Division Engineer, Col. Henry L. Abbot, Corps of Engineers.

1. *Shoals between Sister Islands and Cross-over Light, St. Lawrence River, New York.*—The act of August 11, 1888, provided for a survey of the shoals described, which being made, a report was submitted July 2, 1889, and printed in the Annual Report of the Chief of Engineers, 1889, pages 2463 and 2464. The estimate of cost was $43,305 for a total volume of 2,077 cubic yards of rock to be removed, affording a draft of 18 feet at low water.

Appropriations of $5,000 in 1890 and $10,000 in 1892 were made. Two contracts already completed have accomplished the removal of the two smaller of the three shoals included in the project. Two outlying spurs of one of these shoals, not detected by the first survey, have been included in the project, increasing it to 2,627 cubic yards, and a pro rata revised estimate of $54,772 has been adopted.

July 1, 1893, balance unexpended	$6,711.01
June 30, 1894, amount expended during fiscal year	3,524.51
July 1, 1894, balance unexpended	3,186.50
Amount appropriated by act of August 17, 1894	8,000.00
Amount available for fiscal year ending June 30, 1895	11,186.50
Amount (estimated) required for completion of existing project	31,772.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	31,772.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix Q Q 1.)

2. *Ogdensburg Harbor, New York.*—The improvement of this harbor has been carried on under three successive projects, covering substantially the same area, but providing for a progressive deepening to meet the increasing demand of commerce for draft of water. The last of these projects, now in progress of execution, was adopted in 1890, and contemplates the deepening of the channels leading from the deep water of the St. Lawrence River and along the city front to 16½ feet at extreme low water, at an estimated cost of $158,950. Prior to improvement, depths of 5 to 12 feet prevailed along the city front. There is now a channel 150 feet wide with a clear depth of 16½ feet at extreme low water along the greater part of the city front, with two entrances of equal or greater depth from the river. Under the last contract, completed during the present fiscal year, the 150-foot channel has been extended to and across the mouth of the Oswegatchie and a narrow cut has been run along each side of that stream to reach important terminals.

July 1, 1893, balance unexpended	$44,694.01
June 30, 1894, amount expended during fiscal year	43,746.91
July 1, 1894, balance unexpended	947.10
Amount appropriated by act of August 17, 1894	20,000.00
Amount available for fiscal year ending June 30, 1895	20,947.10
Amount (estimated) required for completion of existing project	56,950.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	56,950.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix Q Q 2.)

3. Breakwater at Rouse Point, Lake Champlain, New York.—The project for this improvement was adopted in 1885, and comprised a straight breakwater composed wholly of stone, with a total length of about 2,000 feet, reaching the 18-foot curve in the lake. The estimated cost was $110,000, or $55 per linear foot.

Appropriations made in 1885, 1886, 1888, 1890, and 1892, aggregated $98,500, and under contracts of corresponding years the breakwater has been completed. Its total length is 1,835 feet, the 18-foot curve having drawn inshore since the preliminary survey on which the estimate was based. The actual expenditures divided by this length gives a cost per linear foot of less than $54, as compared with $55 estimated nine years ago.

July 1, 1893, balance unexpended	$10,269.11
June 30, 1894, amount expended during fiscal year	10,203.40
July 1, 1894, balance unexpended	65.71

(See Appendix Q Q 3.)

4. Great Chazy River, New York.—A survey of this stream from its mouth, on Lake Champlain, to Champlain village was provided for in the act of 1888. The report made was printed in the Report of the Chief of Engineers for 1889, page 2466.

The project adopted was to dredge a channel between the points named in the act 40 feet wide and 5 feet deep, at a cost of $18,000. The act of 1890 appropriated $10,000 to this improvement, which was expended under contract in accordance with the project.

An appropriation of $5,000 was made in the act of 1892, which has been expended under contract during the present fiscal year.

July, 1, 1893, balance unexpended	$4,969.83
June 30, 1894, amount expended during fiscal year	4,630.48
July 1, 1894, balance unexpended	339.35
Amount appropriated by act of August 17, 1894	3,000.00
Amount available for fiscal year ending June 30, 1895	3,339.35

(See Appendix Q Q 4.)

5. Plattsburg Harbor, New York.—This work has been intermittently prosecuted since 1836. Under the project then adopted, and subsequent modifications, a breakwater of a permanent and substantial character, 1,850 feet in length, has been completed. This structure is believed to afford sufficient shelter for the present needs of commerce. In addition to the breakwater, some dredging has been done in the anchorage and a short length of wasting beach has been protected. The total cost of the improvement has been $122,412.03.

July 1, 1893, balance unexpended	$267.97
July 1, 1894, balance unexpended	267.97

(See Appendix Q Q 5.)

6. Burlington Harbor, Vermont.—This improvement dates from 1836, modifications of the original plan having been made from time to time so as to afford adequate protection to the increasing commercial and shipping interests of the harbor. The last modification, made in 1886, provides for further extension of the breakwater, both to the north and to the south, with its gradual withdrawal as it is prolonged, into water about 30 feet deep, instead of 38 feet deep, so as to reduce the cost.

The old parts of the superstructure are much decayed, and the balance of the appropriation of September 19, 1890, $15,565.65, will be expended in repairs, as also the additional funds asked for, if appropriated.

July 1, 1893, balance unexpended	$15,691.83
June 30, 1894, amount expended during fiscal year	126.18
July 1, 1894, balance unexpended	15,565.65
Amount appropriated by act of August 17, 1894	10,000.00
Amount available for fiscal year ending June 30, 1895	25,565.65
Amount (estimated) required for completion of existing project	129,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	25,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix Q Q 6.)

7. *Otter Creek, Vermont.*—The object of this improvement is to afford a channel of navigable width and a depth of 8 feet at low water from the town of Vergennes, Vt., to Lake Champlain. The original project was adopted in 1872, and was estimated to cost $58,146. In 1882 surveys developed the fact that rock in situ would be encountered within the proposed limits of width and depth, and the estimate was increased to $73,748.40. In 1884 a relocation of the channel at Bull Brook Bend avoided a part of the rock excavation, reducing the cost by about $500, and the lower prices which have prevailed in recent years have insured the completion of the project for less than the revised estimate of 1882.

Occasional expenditures for maintenance will doubtless be required. It has been found necessary to repeat operations at Bull Brook Bend, and it is quite probable that accretions will again occur on the shoals there and elsewhere during the season of freshets. Such costs of maintenance will not, it is believed, be excessive in relation to the first cost of the improvement, and they will be very small as compared with the traffic benefited.

During the fiscal year a contract, made under the act of 1892, for rock excavation near the reform school was satisfactorily executed. The completed channel has now reached the public landing, and the amount yet to be appropriated under the revised estimate will suffice to complete the project.

The appropriations to date have aggregated $51,500, which, deducted from the estimate of $73,748.40, leaves a balance of $22,248.40.

July 1, 1893, balance unexpended	$9,740.25
June 30, 1894, amount expended during fiscal year	8,188.88
July 1, 1894, balance unexpended	1,551.37
Amount appropriated by act of August 17, 1894	5,000.00
Amount available for fiscal year ending June 30, 1895	6,551.37
Amount that can be profitably expended in fiscal year ending June 30, 1896	15,000.00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix Q Q 7.)

8. *Ticonderoga River, New York.*—The project for this improvement was adopted in 1881, its object being to afford a channel of navigable width and a least depth of 8 feet at low water from Ticonderoga village to Lake Champlain, a distance of a ... iles. The original estimated cost of the impr ... s $4 ...

The appropr ... m ... 000, was expended under contract, an ... g and removal of 8,132 cubic yards ... th of the river.

The work done under the small appropriation of 1890 was of substantial benefit, though it has lost some of its efficacy through deterioration.

Amount (estimated) required for completion of existing project	$26,016.00
Amount that can be profitably expended in fiscal year ending June 30, 1896.	26,016.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix Q Q 8.)

9. *Narrows of Lake Champlain, New York and Vermont.*—The original project for this work was adopted in 1885, and had for its object the removal of such obstructions in the channel between Whitehall, N. Y., and a point a mile below, known as the Elbow, as would afford a least depth of 12 feet with a least width of 150 feet, and the dredging of the channel along Cedar Mountain and across Kenyon Bay so as to afford a least depth of 12 feet and a width of 200 feet. The estimated cost was $80,000.

Under appropriations in 1886 and 1888, aggregating $45,000, the project was completed, and the resulting channel being found deficient in width at certain sharp bends, a supplementary project was adopted, involving dredging, at an estimated cost of $21,000.

The act of 1892 contained an appropriation of $18,500, making, with the balance in hand, a sum sufficient to complete the project, which was placed under contract.

As the work apparently necessary at the points named in the contract did not reach the estimated quantities, a considerable balance of funds remains available for relief at other localities when it may be needed.

July 1, 1893, balance unexpended	$20,761.16
June 30, 1894, amount expended during fiscal year	15,162.35
July 1, 1894, balance unexpended	5,598.81

(See Appendix Q Q 9.)

PACIFIC COAST.

IMPROVEMENT OF OAKLAND HARBOR, CALIFORNIA.

This work was in the charge of Col. G. H. Mendell, Corps of Engineers, with Lieut. Clement A. F. Flagler, Corps of Engineers, under his immediate orders.

The principal features of this improvement as originally projected are (1) two mid-tide training walls of rubble stone extended from the shore westward into San Francisco Bay about 2 miles; (2) a connection by a canal 1½ miles in length with the estuary of San Leandro; (3) a dam at the mouth of this estuary; (4) dredging of basins and channels to give a depth of 20 feet at low tide, which at high tide will accommodate vessels of the largest class.

Two modifications of the original project have been adopted, namely, to increase the width of tidal canal from 300 to 400 feet, and to raise the height of jetties from half-tide level to full high water.

In the original condition of the entrance the low-water channel depth was about 2 feet, admitting at time of high tide vessels drawing 6 to 8 feet of water. The present navigable condition is a convenient channel from the Bay of San Francisco to and along the city front 300 feet in width and 14 feet in depth at low water, admitting vessels at high water of 19 feet draft.

The channel in the upper bay is 200 feet wide and 8 feet deep at low water. These depths have been well maintained during the year.

The amount expended to June 30, 1893, is $1,551,644.14.

The contract not yet fulfilled, under which operations of last year were conducted, calls for a low-water depth of 20 feet for a distance of 4,600 feet in front of Oakland. This is a mean increase of about 5 feet in depth, nearly one-half of which has been secured, the remainder to follow in the next few months, after which it is expected to extend the depth of 20 feet to San Francisco Bay.

Quantities of work done during the year.—The amount of dredging is 144,854 cubic yards, of which 109,765 cubic yards was dug in the city-front channel and 35,089 cubic yards was dug in the Brooklyn Channel.

The South Jetty was raised and faced with 13,669 tons of stone and with laying 28,206 square feet of dry masonry.

The contemplated operations for the coming year are to extend the 20-foot channel westward; to enlarge the entrance to the canal, and to extend the South Jetty, dependent upon the amount of available funds.

July 1, 1893, balance unexpended		$132,955.86
June 30, 1894, amount expended during fiscal year		67,965.95
July 1, 1894, balance unexpended		64,989.91
July 1, 1894, outstanding liabilities	$9,008.68	
July 1, 1894, amount covered by uncompleted contracts	54,094.00	
		63,102.68
July 1, 1894, balance available		1,887.23
Amount appropriated by act of August 17, 1894		100,000.00
Amount available for fiscal year ending June 30, 1895		101,887.23
Amount (estimated) required for completion of existing project		741,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896		300,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

(See Appendix R R 1.)

IMPROVEMENT OF RIVERS AND HARBORS IN SOUTHWESTERN ARIZONA AND IN CALIFORNIA SOUTH OF SAN FRANCISCO.

This district was in the charge of Lieut. Col. W. H. H. Benyaurd, Corps of Engineers, with Lieut. Charles L. Potter, Corps of Engineers, under his immediate orders.

1. *Napa River, California.*—The project for this improvement is to clear the river of snags and the banks of overhanging trees liable to interfere with navigation and to dredge a channel through the bars between Carr Bend and Vernon Mills in the immediate vicinity of Napa City.

Work upon this improvement was commenced in 1889. The river was cleared of snags and the channel was dredged from Carr Bend to the highway bridge at Third street. This work, completed three years ago, left the river in good boating condition. A survey made last year for the purpose of establishing harbor lines shows that this dredged channel has been almost entirely obliterated, owing to material brought down from the upper reaches of the river during the winter floods. It is not considered that any improvement effected will be permanent, as a channel dredged one season is liable to be filled up during the floods of the succeeding winter. As ordinary tides rise 5 feet and spring tides above 7, it is possible with a moderate amount of dredging from time to time to maintain a good navigable condition of the channel for the class of boats that engage in the trade.

The original estimated cost of this improvement, made in 1885, was $27,500, of which $17,500 has been appropriated and $17,480.65 expended.

A Board of Engineer Officers was convened by Special Orders, No. 28 from Headquarters, Corps of Engineers, July 14, 1893, for the purpose of establishing harbor lines at Napa City. The Board submitted its report October 5, 1893, and the lines recommended received the approval of the Secretary of War October 18, following.

July 1, 1893, balance unexpended	$19.35
July 1, 1894, balance unexpended	19.35
Amount appropriated by act of August 17, 1894	4,000.00
Amount available for fiscal year ending June 30, 1895	4,019.35
Amount (estimated) required for completion of existing project	6,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	6,000.00
Submitted in compliance with the requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix S S 1.)

2. *Redwood Creek, California.*—The improvement is a continuation of that heretofore carried on under appropriations made for the improvement of Redwood Harbor. The creek has been dredged several times, the object being to provide a channel 50 feet wide and 3 feet deep at mean low tide from the lower end of the Tannery Bend to the wharves at Redwood City. From the Tannery Bend to the Bay of San Francisco there is at all stages of the tide a channel of sufficient depth for the class of vessels engaged in the trade.

No work was done during the past year and none is contemplated during the coming season. It is not possible to maintain a good channel through the stretch in question except by constant dredging, as there is always a tendency to refilling, due to local causes.

No appropriation is asked for the coming fiscal year. Funds may be needed in the future to continue the improvement should the commerce of Redwood City justify the expenditure.

The total amount appropriated for dredging at Redwood is $23,400, of which $8,000 was for Redwood Creek, and the total amount expended to the close of the fiscal year, including outstanding liabilities, is $23,386.49.

July 1, 1893, balance unexpended	$13.51
July 1, 1894, balance unexpended	13.51

(See Appendix S S 2.)

3. *San Luis Obispo Harbor, California.*—The project for the improvement of this harbor is intended to protect the anchorage and wharf at Port Harford by the construction of a breakwater on Whaler Reef, extending from Point San Luis to Whaler Island and thence to a point where the outer reef rises above high water. The total length of the structure when completed will be about 2,300 feet. This limitation as to length was fixed by the provisions of the act authorizing the original survey and estimate. The breakwater will rise to a height of 6 feet above high water, with a thickness on top of 20 feet, and with such slopes in front and rear as may be assumed under the action of the seas.

At the close of the last fiscal year that part of the breakwater between the point and the island had been practically completed, and work had been commenced upon the extension on the outer reef and carried for a length of about 340 feet.

Operations were continued during the last season until the 12th of October, when a severe storm with heavy seas completely wrecked the contractor's outfit on the breakwater and caused a suspension of work for the winter. At that time the structure had been extended a further distance of about 170 feet. The seas knocked over the top stones for a length of about 100 feet from the outer end, but left the remainder of the structure practically uninjured. Operations were commenced recently under an extension of time granted the contractor and continued to the end of the year. The total amount of stone placed in the breakwater during the last year was 9,620.5 tons.

During the coming season operations will be carried on under the present contract and with such funds as will be made available.

Owing to the condition of heavy seas and winds that usually prevail at the locality, rendering it difficult and expensive to carry on the work unless extensive plants are provided, and which the small appropriations will not justify, the officer in charge renews his recommendation for suitable appropriations to continue the work.

The total amount appropriated for this improvement is $95,000, and the total amount expended to close of fiscal year, including outstanding liabilities, is $84,906.48.

July 1, 1893, balance unexpended		$28,916.26
June 30, 1894, amount expended during fiscal year		17,739.87
July 1, 1894, balance unexpended		11,176.39
July 1, 1894, outstanding liabilities	$1,082.87	
July 1, 1894, amount covered by uncompleted contracts	10,021.43	
		11,104.30
July 1, 1894, balance available		72.09
Amount appropriated by act of August 17, 1894		40,000.00
Amount available for fiscal year ending June 30, 1895		40,072.09
Amount (estimated) required for completion of existing project		468,660.00
Amount that can be profitably expended in fiscal year ending June 30, 1896		150,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.		

(See Appendix S S 3.)

4. *Wilmington Harbor, California.*—Previous to the commencement of this improvement in 1871, there was a depth of less than 2 feet at low tide at the entrance. Vessels anchored in the open roadstead outside and transferred their freight by lighters to the wharves inside. Since the above date the operations of jetty construction and dredging have secured a depth of about 14 feet at mean low tide at the entrance and about 16 feet in the channel inside, with lesser depths along portions of the wharf fronts.

The original project contemplated gaining a depth of 10 feet at mean low tide at the entrance. This having been accomplished in 1881 a further project was presented for increasing the depth to 16 feet at same stage, which would permit vessels drawing from 20 to 22 feet to enter at high tide. Up to June 30, 1893, there had been expended upon this improvement $918,238.88, and a depth of about 14 feet had been gained at the entrance and about 16 feet inside.

Work during the past year has consisted in raising the east jetty just within Deadmans Island, in further extending this jetty 425 feet beyond the island, and in raising and extending the west jetty. The stone for this work was delivered under a contract made the previous year and the work was done by hired labor with the plant owned by the Government. Surveys of the entrance and inner harbor were completed and borings were made to determine the character of the underlying strata at the entrance, with a view to future operations.

The depth of 14 feet at the entrance has been maintained and the channel is apparently undergoing improvement. The ship *Forest Queen* entered the harbor on the 15th of May drawing 18.9 feet, the stage of tide being 5.6 feet. Owing to shallow depths along portions of the wharf fronts she was unable to unload except at the higher stages of tide.

The change of depths at the entrance, due to the extension of the jetties, takes place very slowly, so that it is not possible to predict when the depth of 16 feet contemplated will be obtained. Appropriations made in the future will be expended in increasing the depth at the entrance and in dredging the interior basin between harbor lines.

The total amount appropriated for this work is $955,000 and the total amount expended to close of fiscal year, including outstanding liabilities, is $950,213.68.

July 1, 1893, balance unexpended	$38,880.48
June 30, 1894, amount expended during fiscal year	34,019.16
July 1, 1894, balance unexpended	4,861.32
July 1, 1894, outstanding liabilities	75.00
July 1, 1894, balance available	4,786.32

(See Appendix S S 4.)

5. *San Diego Harbor, California.*—Before the adoption of the present project the work carried on had for its object the preservation of the harbor, which was being injured by the deposition of material brought down the San Diego River during flood stages. A dike was built across the mouth of the river and a new channel cut, causing the river to empty into False Bay. This work was completed in 1876.

The present project contemplates the preservation and repair of the above dike, the deepening of the channel over the bar by the construction of a jetty on Zuninga Shoal, so as to secure a depth of 26 feet at mean low tide, and the deepening of the channel through the middle ground just within the entrance to the harbor.

Jetty.—Work was commenced upon the jetty in August last, under contract with Silas R. Smith, and continued until the end of the year. The work done consisted in a strong stone revetment about 1,000 feet in length along the shore of North Coronado Island, from whence the jetty starts; the construction of 2,464.5 feet of double-track trestle along Zuninga Shoal; the completion of the jetty to high water for a length of 1,860 feet, to low water for 196 feet additional, and a brush and stone foundation for a further distance of 418 feet.

The works, as far as constructed, have had no effect upon the bar depth, and none is expected until the jetty shall have been extended a considerable distance seaward, so as to direct the tidal flow over the bar.

During the coming season work will be continued upon the construction of the jetty to extent of the funds made available. Under the above-mentioned contract there is yet to be delivered about 4,600 tons of rock for the jetty.

Middle ground.—No work was done at this point during the past year. The channel depth remains the same as last reported, viz, 16½ feet. It is not contemplated to take up the dredging again until the jetty shall have been extended sufficiently far to cut off the movement of sand over Zuninga Shoal, and thereby permit a permanent channel to be made and maintained at the middle ground by dredging.

Dike.—This work is in good condition. It will be examined from time to time and such repairs as appear necessary will be made.

The total amount appropriated for the dike at San Diego Harbor since 1875 is $82,500, and the total amount expended is $82,085.37.

For the jetty and middle ground $110,000 has been appropriated, and the amount expended, including outstanding liabilities, is $92,408.11.

July 1, 1893, balance unexpended		$88,732.15
June 30, 1894, amount expended during fiscal year		55,810.50
July 1, 1894, balance unexpended		32,921.65
July 1, 1894, outstanding liabilities	$14,915.13	
July 1, 1894, amount covered by uncompleted contracts	15,148.34	
		30,063.47
July 1, 1894, balance available		2,858.18
Amount appropriated by act of August 17, 1894		50,000.00
Amount available for fiscal year ending June 30, 1895		52,858.18
Amount (estimated) required for completion of existing project		234,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896		200,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.		

(See Appendix S S 5.)

6. *Colorado and Gila rivers at Yuma, Ariz.*—The river and harbor act of July 13, 1892, made an appropriation of $10,000 for improving the Colorado River and provided for "the construction of a levee along the Gila River near its junction with the Colorado so as to confine the waters to the channels of said rivers." After surveys had been made and the right of way obtained, specifications were issued and proposals were invited for the construction of the proposed levee. A contract was entered into September 19, 1893, with Baker & McKeone, the lowest bidders, at a price of 12½ cents per cubic yard. Work was commenced in October, 1893, and completed the following January. The total amount of material placed in the levee was 53,807 cubic yards. The levee is about 3,400 feet long and has a crown of 8 feet and slopes inside and outside of 1 on 2 and 1 on 3, respectively. It runs from Penitentiary Hill, following a slough along the eastern boundary of Yuma, and terminates where the embankment of the Southern Pacific Railroad crosses Seventh street, near Gila street. In constructing the levee advantage was taken of an old levee line located by the village authorities several years before, as the main object to be fulfilled, viz, the protection of Yuma against floods, could be obtained at less cost by following this line rather than a longer one along the Gila River.

The work is in good condition.

The total amount appropriated for this improvement is $10,000, and the total amount expended is $9,640.09.

July 1, 1893, balance unexpended	$9,503.07
June 30, 1894, amount expended during fiscal year	9,143.16
July 1, 1894, balance unexpended	359.91

(See Appendix S S 6.)

IMPROVEMENT OF SAN JOAQUIN AND SACRAMENTO RIVERS AND TRIBUTARIES AND OF RIVERS AND HARBORS IN CALIFORNIA NORTH OF SAN FRANCISCO.

This district was in the charge of Maj. W. H. Heuer, Corps of Engineers, having under his immediate orders Lieut. Herbert Deakyne and Lieut. Graham D. Fitch, Corps of Engineers, since July 19 and October 9, 1893, respectively; Division Engineer, Col. G. H. Mendell, Corps of Engineers.

1. *San Joaquin River, California.*—Before improvement the low-water channel to Stockton was only about 6 feet in depth, while the upper river, above Stockton, was navigable for but a few months in the year for light draft boats.

The project for the improvement, which was adopted in 1877 and slightly modified later, had for its object to secure and maintain by dredging a channel 9 feet deep at low water and 100 feet wide through the tidal portions of the river and Stockton Slough to Stockton, and a channel 4 feet deep at low water and 100 wide to Miller's warehouse in Mormon Slough; to secure the temporary improvement of the low-water channel by dredging, scraping, and small wing dams, and to effect the closure or partial closure of Paradise Cut and Laird Slough.

The amount expended to June 30, 1893, was $280,750.85, with the result of providing a low-water channel of 9 feet to Stockton and of improving the upper river by the partial closure of Paradise Cut and Laird Slough. Steamboating to Stockton was thus rendered comparatively easy and safe all the year round, but the annual time of navigation on the upper river was not materially lengthened.

During the past fiscal year the United States dredge removed a sandbar at Wakefield Landing, a hard-pan bar at Raggi Landing (both to a depth of 9 feet below water), and made cuts in Stockton Slough aggregating 3,585 feet in length to a width of 50 feet and a depth of 9 feet below low water. The dredge worked one hundred and five days and removed 59,916 cubic yards of material at a cost of 7.9 cents per cubic yard.

On July 23, 1893, a contract was entered into with John Hackett for dredging a double cut off in the San Joaquin River near Stockton. The cut was completed on September 11, after 110,093 cubic yards of material had been removed; it is 1,900 feet long, 150 feet wide, 9 feet deep at mean low water. On September 14, 1893, a contract was entered into with the San Francisco Bridge Company for making a double cut-off at Twenty-one Mile Slough, San Joaquin River. The cut was completed on October 17, after 204,422 cubic yards of material had been removed. The east portion of the cut is 1,250 feet long and the west portion 2,525 feet long; the cut is 100 feet in width at bottom, and 9 feet in depth at mean low water.

During the year a low-water channel of 9 feet to Stockton has been maintained, and navigation has been rendered easier by the cut-offs made.

The following is a list of the works needed for the further improvement of this river, with the estimated cost of the several items:

1. Dredging to maintain 9 feet depth to Stockton	$35,000
2. Increasing cut-off at Head Reach in width, depth, or both	27,750
3. Removing obstructions near county bridge above Stockton Slough	5,000
4. Increasing cut-off at Twenty-one Mile Slough in width, depth, or both	20,000
5. Snagging, wing dams, etc	10,000
Total	107,750

All of the above amounts can be advantageously expended in one fiscal year.

July 1, 1893, balance unexpended	$43,044.15
June 30, 1894, amount expended during fiscal year	40,554.59
July 1, 1894, balance unexpended	2,489.56
Amount appropriated by act of August 17, 1894	50,000.00
Amount available for fiscal year ending June 30, 1895	52,489.56
Amount that can be profitably expended in fiscal year ending June 30, 1896 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	107,750.00

(See Appendix T T 1.)

2. *Mokelumne River, California.*—Before improvement, navigation on this river was difficult and dangerous on account of numerous bad snags and overhanging trees.

The original project, adopted in 1884 and still in force, had for its object the removal of trees and snags obstructing navigation.

The amount expended up to June 30, 1893, on the improvement of this river was $12,480.70.

The river was cleaned out to the head of navigation in 1884, 1885, 1886, 1887, and 1888, and navigation was made easy and safe.

The results obtained were not permanent, but as the act of July 13, 1892, appropriating funds for this river provided that none should be expended until a drainage canal, dug by private parties near New Hope Landing, should be closed free of expense to the Government, the commencement of the work was delayed. This has finally been done, and work will be resumed.

No work was done during the last fiscal year.

The improvements now needed for the safe navigation of this river are the removal of the snags and trees obstructing navigation, of a point of land near New Hope Landing, and of a shoal formed below the drainage canal. The estimated cost of these works is $9,100, and they could all be done in one fiscal year.

July 1, 1893, balance unexpended	$3,019.30
July 1, 1894, balance unexpended	3,019.30
Amount appropriated by act of August 17, 1894	2,500.00
Amount available for fiscal year ending June 30, 1895	5,519.30
Amount that can be profitably expended in fiscal year ending June 30, 1896 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	9,100.00

(See Appendix T T 2.)

3. *Sacramento and Feather rivers, California.*—Before improvement, navigation in these rivers was dangerous and difficult on account of numerous snags, shallow bars, and rapids.

In 1874 a project was adopted having for its object the temporary improvement of the low-water channels by removing snags, scraping bars, and building wing dams. Work has been continuous on this project ever since, whenever funds permitted.

In 1892 the project was modified and increased to include the closure of Jacob Slough, the construction of wing dams on the Feather River, and the treatment of the Yuba River near and above Marysville.

The amount expended to June 30, 1893, was $504,537.48, with the result of securing on the Sacramento River a good navigable channel from Tehama to Butte City for boats drawing 2½ feet, from that point to Sacramento 4 feet of water, and below Sacramento a low-water channel with a least depth of 8 feet, except at one point.

During the past fiscal year Jacob Slough was closed by a levee 2,690 feet long, built around the crevasse, at a cost of $10,732.99; a new mouth was made for the Yuba River by means of a cut 2,500 feet in length, at a cost of $45,294.75; surveys were made on the Yuba and Sacramento rivers, and the United States snag boat built 270 linear feet of wing dams and removed 939 snags and 4 trees from the Upper Sacramento and 22 snags from the lower river, at a total cost of $12,896.21.

The river is in good navigable condition to Red Bluff, the head of navigation. There is now no impediment to navigation except at Heacocks Shoals, where a least depth of 6 feet of water is found and for the improvement of which a project has been submitted.

July 1, 1893, balance unexpended	$140, 462. 52
June 30, 1894, amount expended during fiscal year	73, 777. 44
July 1, 1894, balance unexpended	66, 685. 08
July 1, 1894, outstanding liabilities	1, 500. 00
July 1, 1894, balance available	65, 185. 08
Amount appropriated by act of August 17, 1894	115, 000. 00
Amount available for fiscal year ending June 30, 1895	180, 185. 08
Amount that can be profitably expended in fiscal year ending June 30, 1896 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	55, 000. 00

(See Appendix T T 3.)

4. *Petaluma Creek, California.*—Before improvement the channel was very crooked and, in places, dry at low water, making navigation difficult and uncertain.

In 1880 a project was adopted for its improvement by which it was designed to obtain by dredging a channel 50 feet wide by 3 feet deep at low water.

The amount expended up to June 30, 1893, was $41,287.93, and a channel 5,107 feet long, 50 feet wide, and 3 to 4 feet deep secured.

During the past fiscal year 50,864 cubic yards of material had been excavated and placed on shore by the United States dredge. The length of the channel dredged was 5,973 feet. This was dug 50 feet wide to a depth of 3 to 4 feet below low water. The channel now reaches the town of Petaluma, and is of the greatest benefit to commerce.

A channel should be dredged, with a depth of 5 feet at low water, to the head of navigation. This would require the removal of 214,173 cubic yards of material. The estimated cost is $53,543. It could be done in one fiscal year. As this channel is not self-maintaining, dredging, at an estimated cost of $4,000, would be required about once in every two years.

July 1, 1893, balance unexpended	$4, 712. 07
June 30, 1894, amount expended during fiscal year	4, 570. 12
July 1, 1894, balance unexpended	141. 95
Amount appropriated by act of August 17, 1894	15, 000. 00
Amount available for fiscal year ending June 30, 1895	15, 141. 95
Amount that can be profitably expended in fiscal year ending June 30, 1896 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	53, 543. 00

(See Appendix T T 4.)

5. *Humboldt Harbor and Bay, California.*—Before improvement, entrance to the harbor was obstructed by a bar, the channel through which was variable in position (from southwest to north-northwest, 1½ miles apart at the sea ends) and variable in width (from 2,200 feet to 4,200 feet). There were also numerous shoals in the bay, so that before improvement the channel to Eureka had a depth of 7 feet and the channels to Arcata and Hookton had depths of 6 feet only, rendering it difficult for vessels to reach the wharves.

In 1881 a project was adopted with the object of securing a channel 13 feet deep and 200 feet wide to Eureka, and one 10 feet deep and 100 feet wide to Arcata and Hookton. This project was completed in 1884, at a cost of $96,061.55.

In 1882 a further project was adopted with the view of improving the bar at the entrance. This was to be done by constructing a low-tide stone jetty running out from the south spit in a northwesterly direction for a distance of 6,000 feet. After work was begun, great scour occurred on the north spit; accordingly in 1891 the project was enlarged to embrace the construction of a jetty on the north spit. This jetty was not to be begun until the completion of the south jetty. Both jetties were to be built up to high tide and were to extend seaward to the 18-foot contour. To check the erosion of the north spit a dike about 1,500 feet long had been constructed in 1891. Erosion still continuing, the project was again somewhat modified in 1892. These modifications consisted in relocating the north jetty so as to make the previously built dike part of the jetty, and in authorizing the construction of the north jetty sufficiently far to arrest erosion without waiting for the completion of the south jetty.

The amount expended on jetty work up to June 30, 1893, was $338,893.31. The south jetty was then 3,699 feet long and the north jetty 2,293 feet long. Owing to the incomplete condition of the jetties, no conspicuous improvement had occurred in the depths over the bar; a channel 18 feet in depth had been maintained, however, and no vessels were delayed on account of insufficient depth of water.

At the beginning of the fiscal year work was in progress under the contract of December 16, 1892, with John C. Bull, jr., and was continued throughout the year, with an intermission from February 2, 1894, to the latter part of April. The work was mainly confined to the north jetty, which is now 5,178 feet long, and completed for a length of 3,767 feet. During the fiscal year the work done on this jetty amounted to 2,674 feet of trestle, 14,343 cubic yards of brush mattresses, and 72,483 tons of rock. The only work done on the south jetty during the year was the construction of five spurs built to resist the encroachments of the channel and the revetment of the channel slope. This work amounted to 555.23 cubic yards of brush and 19,758 tons of rock.

A survey of the entrance in May, 1894, showed that a marked improvement had taken place. There is now a channel over the bar 24 feet deep with a least width of 950 feet.

July 1, 1893, balance unexpended		$680,741.59
June 30, 1894, amount expended during fiscal year		162,725.18
July 1, 1894, balance unexpended		518,016.41
July 1, 1894, outstanding liabilities	$630.00	
July 1, 1894, amount covered by uncompleted contracts	517,386.41	
		518,016.41

Amount (estimated) required for completion of existing project	$1,043,115.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	225,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix T T 5.)

IMPROVEMENT OF CERTAIN RIVERS AND HARBORS IN OREGON, WASHINGTON, AND IDAHO.

This district was in the charge of Capt. Thomas W. Symons, Corps of Engineers, to October 13, 1893, and since January 18, 1894, having under his immediate orders Lieut. F. R. Shunk, Corps of Engineers, the entire period, and Lieut. Graham D. Fitch, Corps of Engineers, to October 6, 1893, and in the temporary charge of Lieutenant Shunk from October 13, 1893, to January 18, 1894; Division Engineer, Col. G. H. Mendell, Corps of Engineers.

1. *Coquille River, Oregon* (*general improvement*).—Before improvement the entrance to the Coquille River was considered very dangerous. The channel was usually long, tortuous, and narrow, skirting the south headland, and studded with rocks from the bar to a distance of one-half mile inside. Its depth was only about 3 feet at low water. It was, however, constantly shifting, and at long intervals would break through the north spit and run out to sea just south of Rackliffe Rock. At such times the channel was at its best, and the entrance was comparatively safe; but this condition never lasted long. The mean range of tide is 4.1 feet.

The first plan of improvement was to construct two parallel high-tide stone jetties, 800 feet apart, running out to sea a sufficient distance to scour and maintain a channel with a least depth of 8 feet over the bar at low water; the north jetty to start from Rackcliffe Rock, and the south jetty from a point inside the entrance. In 1891 the project was changed to provide for an entrance width of 600 feet instead of 800 feet. The estimated cost was $164,200. In 1892, when $105,000 had been expended, the cost of completing the project was reestimated at $180,000, making a total estimated cost of $285,000.

The amount expended prior to June 30, 1893, was $119,117.57, including $6,883.90 expended for snagging on the upper river.

As a result, the entrance was for considerable periods kept straight, with a depth of 8 to 10 feet at low water. At other times winds and tides would heap sand into the channel, causing the waters to spread out and shoal, or to form a new channel, shallow and unfavorably directed to the northward.

The amount expended during the year ending June 30, 1894, was $8,868.03.

The jetties were strengthened without being extended, and the condition of the entrance is about as it was before.

The appropriations amount to $150,000.

July 1, 1893, balance unexpended	$10,933.95
June 30, 1894, amount expended during fiscal year	8,868.03
July 1, 1894, balance unexpended	2,065.92
July 1, 1894, outstanding liabilities	600.00
July 1, 1894, balance available	1,465.92
Amount appropriated by act of August 17, 1894	20,000.00
Amount available for fiscal year ending June 30, 1895	21,465.92

Amount (estimated) required for completion of existing project	$135,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	50,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix U U 1.)

2. *Coquille River, Oregon, between Coquille City and Myrtle Point.*—The Coquille is one of the principal streams of southern Oregon. It is navigated by coasting vessels from its mouth to Coquille City, a distance of 25 miles. This portion of the river has at times been more or less obstructed by snags, but no serious shoals have formed.

Above Coquille City river steamers ply as far as Myrtle Point, a distance of 12 miles. It has always been difficult to keep this portion of the river open. The drainage area is densely wooded, and every freshet brings down many stumps, logs, and trees; these lodge and arrest sediment, forming shoals.

The plan of improvement is to remove all objectionable snags, and to contract the river at certain shoals to a width of 50 feet, in order that the shoals may scour away. The estimated cost is $26,000.

Until the fiscal year ending June 30, 1893, this work was done with certain sums diverted from the appropriation for the mouth of the river. A total of $6,883.90 was so expended. The act of July 13, 1892, made a separate appropriation for the upper river. From this time to June 30, 1893, the amount expended was $5,000. A great many snags were removed, but while this was of benefit to navigation, the river has filled up to a considerable extent with alluvium, so that its navigable capacity was not increased.

No money was expended during the year ending June 30, 1894, and no results obtained. A great many snags have lodged in the river, chiefly in the upper portion.

The appropriations amount to $10,000.

Amount appropriated by act of August 17, 1894	$5,000.00
Amount (estimated) required for completion of existing project	16,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	16,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix U U 2.)

3. *Entrance to Coos Bay and Harbor, Oregon.*—Before improvement the obstructions at the entrance to this harbor were first, the sandy shifting outer bar, and second, the inner sandy shoals accumulated by the northwest winds of spring, summer, and autumn.

The winds also caused the north spit to extend southward, greatly contracting the navigable channel and making the outer channel follow the west side of the spit in a long and tortuous course across the bar. The channel would at times break through the north spit on a line whose general direction is from Fossil Point to a point just north of Coos Head. It was then direct, its depth greatest, and vessels could pass without trouble. The mean range of the tide was 5.6 feet.

A project was adopted in 1879 to build, at an estimated cost of $600,000, such a stone and wood jetty as might be found best from a point 250 yards below the northern extremity of Fossil Point on a line towards the east end of Coos Head, curving at its outer end so as to be directed a little north of the Head. The object was to prevent the extension of the north spit and to open and maintain a deeper and more direct channel across the bar. This project has been abandoned.

The present project is to build two high-tide stone jetties, one from Coos Head and one from the south end of the north spit, extending out towards the bar and leaving an entrance about 1,500 feet wide. The project also includes the protection of the north spit by plantations to prevent sand from blowing into the harbor. The estimated cost is $2,466,412.20.

The amount expended prior to June 30, 1893, was $210,337.74 on the old project, and $214,444.36 on the new, a total of $424,782.10.

The north jetty tramway had been built to a total length of 9,232 feet. A vast amount of sand had been impounded and a minimum depth of 12 feet at low water maintained over the bar.

The amount expended during the year ending June 30, 1894, was $116,037.89.

The north jetty tramway is 9,520 feet long, and its enrockment well advanced. The channel has greatly improved, there being now a least depth of 20 feet at mean lower low water.

July 1, 1893, balance unexpended	$123, 993. 76
June 30, 1894, amount expended during fiscal year	116, 037. 89
July 1, 1894, balance unexpended	7, 955. 87
July 1, 1894, outstanding liabilities	2, 500. 00
July 1, 1894, balance available	5, 455. 87
Amount appropriated by act of August 17, 1894	108, 000. 00
Amount available for fiscal year ending June 30, 1895	113, 455. 87
Amount (estimated) required for completion of existing project	2, 036, 412. 20
Amount that can be profitably expended in fiscal year ending June 30, 1896	600, 000. 00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

(See Appendix U U 3.)

4. *Umpqua River, Oregon.*—Just below Scottsburg, the head of navigation on the Umpqua River, there are five sandstone ledges 12 to 15 feet wide and from 1 to 2 feet below low tide at a low river stage. They are separated by pools about 150 feet wide and 5 to 10 feet deep at low water. The first plan of improvement was to blast out a channel 50 feet wide and 3 feet deep through these ledges. The estimated cost was $4,056. In 1889 the proposed depth was increased to 4 feet, and the cost of completion estimated at $9,000. It was found during the past year that this estimate was insufficient and the cost of the completion of the project was estimated at $6,000, making a total estimated cost of $21,685.89.

The amount expended prior to June 30, 1893, was $14,245.16. A large amount of rock was removed and navigation thereby benefited.

The amount expended during the year ending June 30, 1894, was $1,233.15. Two hundred and fifty-two and five-tenths tons of rock had been removed when the appropriation gave out. The proposed channel is not completed.

The appropriations amount to $33,500, of which $17,814.11, appropriated in 1871, was expended prior to the adoption of the present project.

July 1, 1893, balance unexpended	$1, 443. 46
June 30, 1894, amount expended during fiscal year	1, 233. 15
July 1, 1894, balance unexpended	210. 31
Amount (estimated) required for completion of existing project	6, 000. 00
Amount that can be profitably expended in fiscal year ending June 30, 1896	6, 000. 00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

(See Appendix U U 4.)

5. *Mouth of Siuslaw River, Oregon.*—The Siuslaw River enters the ocean in the midst of a vast shifting sandy beach, without any headland or fixed point to determine the location of the entrance channel. The unconfined channel has a range of about 1 mile over which it wanders. The depth on the bar varies from 5 to 12 feet at low water, and the bar channel is very variable in position and direction. At times a channel running nearly parallel with the coast is developed inside the bar. This channel is narrow, ill-defined, and dangerous, as boats have to pass through it in the trough of the sea. At other times there are two channels.

The plan of improvement is to confine the waters between high-tide brush and stone jetties, so located as to direct the currents upon the bar in a direction practically perpendicular to the coast. The north jetty will be 4,500 feet long, the south jetty 3,200 feet long, and they are to converge to an entrance 600 feet wide at the crest of the bar. The estimated cost is $700,000.

The amount expended prior to June 30, 1893, was $65,044.70. The tramway was built to a length of 3,029 feet and partially enrocked, but the work had not progressed sufficiently to produce any results of importance.

The amount expended during the year ending June 30, 1894, was $3,606.38.

No work was done upon the project. During the year the tramway and wharf were badly damaged by storms and slides.

The appropriations amount to $95,000.

July 1, 1893, balance unexpended	$4,955.30
June 30, 1894, amount expended during fiscal year	3,606.38
July 1, 1894, balance unexpended	1,348.92
July 1, 1894, outstanding liabilities	600.00
July 1, 1894, balance available	748.92
Amount appropriated by act of August 17, 1894	25,000.00
Amount available for fiscal year ending June 30, 1895	25,748.92

Amount (estimated) required for completion of existing project	605,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	50,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix U U 5.)

6. *Yaquina Bay, Oregon.*—Before improvement the usual low-water depths over the bar at Yaquina Bay were from 7 to 8 feet. There were three distinct channels, known as the North, Middle, and South channels. The South Channel was the one mostly used, but was rendered dangerous by rocks. The Middle Channel, though free from rocks, was little used, being usually the shoalest. The North Channel, besides being long and tortuous, was so studded with rocks as to be considered unnavigable. These channels were constantly shifting and changing in depth.

A project was adopted in 1881 to construct a stone jetty on the south side, at an estimated cost of $465,000, in order to cause the South Channel to shoal up, and to obtain a least high-water depth of 17 feet in the Middle Channel. The jetty was to be 2 feet above mean low water, and was to run out to sea a distance of 2,500 feet from low-water line. The stone was to be deposited from barges, and cribs were to be used if possible. Both were found impossible, owing to rough water, and the jetty had to be built from a tramway begun at the high-tide line, making the projected length about 4,000 feet.

The present project, adopted in 1888, is to raise the south jetty to high-tide level without further extension, and to build a mid-tide jetty on the north side about 2,300 feet long from the North Head to a point opposite the end of the south jetty and about 1,000 feet from it. This project has been modified to provide for raising the north jetty to high-tide level, and for building five groins from the south jetty toward the channel. The estimated cost, from the beginning, is $755,560.30.

The amount expended prior to June 30, 1893, was $600,849.84. As a result the condition of the entrance was very satisfactory, there being a minimum depth over the bar of 14 feet at low water. Trouble was threatened, however, by the formation of a bar inside the entrance.

The amount expended during the year ending June 30, 1894, was $25,398.93. The results are practically the same as before. The inner bar disappeared during 1893, but has re-formed. It has not yet become an actual obstruction, but threatens to be one.

The appropriations amount to $685,000.

July 1, 1893, balance unexpended	$34,305.59
June 30, 1894, amount expended during fiscal year	25,398.93
July 1, 1894, balance unexpended	8,906.66
July 1, 1894, outstanding liabilities	100.00
July 1, 1894, balance available	8,806.66
Amount appropriated by act of August 17, 1894	50,000.00
Amount available for fiscal year ending June 30, 1895	58,806.66
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	70,000.00

(See Appendix U U 6.)

7. *Tillamook Bay and Bar, Oregon.*—Tillamook Bay is 50 miles south of the Columbia River. Its tidal area is 13.5 square miles, the mean range of tide being 6.5 feet. The channel over the entrance bar is one of the safest on the coast, as it is direct and shifts but little.

The bay at low tide is reduced to three channels running through sand and mud flats. The depth of water in these channels is fair at the entrance, but decreases to 1 or 2 feet at the head of the bay. Tillamook City, the chief town on the bay, is situated on Hoquarton Slough, a tidal inlet reached by the middle channel. The other places of importance are on the north channel. The only connection between these two channels is near the mouth of the bay.

The plan of improvement is to make a navigable pass between the north and middle channels, to deflect the waters of the south into the middle channel by building a dike at Junction Bar and to close one of the two channels at Dry Stocking Bar in Hoquarton Slough.

The estimated cost is $100,000.

The amount expended prior to June 30, 1893, was $5,996.18. This was expended upon an obsolete project and upon a survey of the bay and bar. No results in the way of improvement were obtained.

The amount expended during the year ending June 30, 1894, was $10,700.72.

The dikes were built at Dry Stocking and Junction bars, the latter not to its full projected length. There is not yet a continuous navigable channel.

The appropriations amount to $36,700.

July 1, 1893, balance unexpended	$14,703.82
June 30, 1894, amount expended during fiscal year	10,700.72
July 1, 1894, balance unexpended	4,003.10
Amount appropriated by act of August 17, 1894	16,000.00
Amount available for fiscal year ending June 30, 1895	20,003.10
Amount (estimated) required for completion of existing project	69,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	50,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix U U 7.)

8. *Entrance to Nehalem Bay, Oregon.*—Nehalem Bay at high water is about 2 miles long by 1¼ miles wide at the widest part, and is connected with the ocean by a narrow channel extending in a southerly direction about 3 miles. This channel varies in width from 1,000 to 2,000 feet at high tide. It is separated from the ocean by a low sandy peninsula about 2½ miles long and one-fourth mile wide. The entrance channel south of this peninsula is shifting, its northern and southern limits being about one mile apart. The channel across the bar at the entrance is ordinarily 5 to 6 feet deep at low tide.

The plan of improvement is to hold the channel in its southern position by building two high-tide stone jetties, the northern starting from the above-mentioned peninsula and the southern from the mainland; these to converge to an entrance width of about 500 feet, and then, if necessary, to run parallel for a sufficient distance to secure a bar depth of 8 feet at low water. The estimated cost is $712,338.

The amount expended prior to June 30, 1893, was $415.08. No work was done beyond making a survey.

There was no expenditure during the year ending June 30, 1894, and no results were obtained.

The appropriation (1890) is $10,000.

July 1, 1893, balance unexpended	$9,584.92
July 1, 1894, balance unexpended	9,584.92
Amount (estimated) required for completion of existing project	702,388.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix U U 8.)

9. *Upper Snake River, Idaho, between Huntington Bridge and Seven Devils mining district.*—This portion of the Snake River flows through a deep canyon, and is swift, with many rapids and dangerous rocks. The bed and banks are hard basalt and granite. Navigation is almost impossible.

The plan of improvement is to remove rocks and reefs from a channel 150 feet wide, and to put in ringbolts and iron posts to assist boats in lining up. The estimated cost is $80,000.

The amount expended prior to June 30, 1893, was $17,998.46. A large amount of rock was removed from the channel just below Huntington Bridge.

The amount expended during the fiscal year ending June 30, 1894, was $1,252.66. No work was done under the project, and no results obtained.

The appropriations amount to $45,000.

July 1, 1893, balance unexpended	$2,001.54
June 30, 1894, amount expended during fiscal year	1,252.66
July 1, 1894, balance unexpended	748.88
Amount appropriated by act of August 17, 1894	25,000.00
Amount available for fiscal year ending June 30, 1895	25,748.88
Amount (estimated) required for completion of existing project	35,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	25,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix U U 9.)

10. Upper Columbia and Snake rivers, Oregon and Washington.—Under the above head are included the continuous Columbia and Snake rivers from Celilo, at the head of The Dalles, to Asotin, Wash. The Upper Columbia and Snake form a continuous line of river which is navigable, but broken by many rapids which render navigation difficult and dangerous. These rapids are in nearly every instance caused by rocky bars with occasional bowlders. The channels before improvement were crooked and narrow, the ruling depth at low water over many of the bars was 2 to 3 feet, and some were practically impassable at low water. The Columbia was navigable all the year unless closed by ice. The Snake, however, was navigable only during high water, for two or three months in the spring.

Before 1877, $120,000 had been appropriated for the work of improvement, and had been expended in surveys and in rock removal at the principal rapids. In 1877 a project was approved which provided for the removal of bowlders and reefs, and for scraping gravel bars in the rivers as far as Lewiston. The estimated cost was $132,000.

In 1892 the upper limit of the work was extended 7 miles to Asotin, Wash.

The present plan of improvement is to remove bowlders, gravel bars, and rock ledges, and put in such contraction works as may be necessary.

The estimated cost of the work has not been accurately determined, because of the lack of continuous and full surveys, and because many of the obstructions which it is necessary to remove are continually recurring.

The amount expended on the present project prior to June 30, 1893, was $162,965.98.

The worst rocks and reefs between Riparia and Asotin were removed, with great benefit to navigation. At two of the worst bars dikes were built which have considerably improved the channel.

The amount expended during the year ending June 30, 1894, was $2,743.98. The results are about as before.

The appropriations amount to $276,000.

July 1, 1893, balance unexpended	$3,189.46
June 30, 1894, amount expended during fiscal year	2,743.98
July 1, 1894, balance unexpended	445.48
Amount appropriated by act of August 17, 1894	5,000.00
Amount available for fiscal year ending June 30, 1895	5,445.48
Amount that can be profitably expended in fiscal year ending June 30, 1896	20,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix U U 10.)

11. Columbia River between head of Rock Island Rapids and foot of Priest Rapids, Washington.—This portion of the Columbia River is about 60 miles long. The banks are precipitous bluffs, from 1,000 to 3,000 feet high. The neighboring country is rocky and sterile. Navigation is obstructed by Rock Island, Cabinet, and Priest rapids.

At Rock Island Rapids the river is divided by a large rocky island. The channel is obstructed by reefs, rocks, sharply projecting points, and extensive gravel deposits, which dam up the water to such an extent that its slope in escaping is very steep. The river here, at a stage 4 feet above low water, has a fall of 10 feet in 3,000 feet, and 12½ feet in 8,000 feet.

At Cabinet Rapids, a mass of basalt projecting from the left bank causes the current to impinge upon the nearly vertical rocks of the right bank; the channel is also obstructed by masses of rock. The fall here is 10 feet in 8,000 feet.

Priest Rapids include seven principal rapids in about 10 miles. The total fall in this distance is 72 feet at low water and 63½ feet at high water. At all these rapids the banks and bottom are of hard and jagged basalt.

The plan of improvement is to remove rocks at the three rapids, and put in iron posts and ringbolts to enable steamers to line up. The cost of this work was estimated at $550,000, but subsequent study and consideration make it practically certain that neither this nor any other sum in reason will be sufficient to attain the object aimed at. In addition, the project included a survey from Rock Island Rapids to the Canadian boundary.

The amount expended on the river prior to June 30, 1893, was $51,789.08; on the survey, $10,000.

The survey was completed from the Canadian boundary to the mouth of the Okanogan. The worst obstructions were removed from the channel at the three rapids, and a number of posts and ringbolts put in. The results would have rendered navigation safer had there been any navigation.

The amount expended during the year ending June 30, 1894, was $200.31. No work was done under the project, and no further results obtained.

The appropriation amounts to $70,000.

July 1, 1893, balance unexpended	$8, 210. 92
June 30, 1894, amount expended during fiscal year	200. 31
July 1, 1894, balance unexpended	*8, 010. 61

(See Appendix U U 11.)

12. Willapa River and Harbor, Washington.—Willapa Harbor, formerly known as Shoalwater Bay, is 28 miles north of the mouth of the Columbia. The principal town on the harbor is South Bend, the terminus of a branch line of the Northern Pacific Railroad, situated near the mouth of the Willapa River. At the upper end of the town the river divides into a main and a secondary channel, the latter known as Mailboat Slough; these reunite at the lower end of the town. Bars had formed in the main channel at both ends of the slough. There were also several bars in the Willapa River between South Bend and Willapa City.

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[*] The act of August 17, 1894, appropriates this balance for the building of a snag boat and for other necessary work between Rock Island Rapids and Foster Creek Rapids.

The plan of improvement is to close the head of Mailboat Slough with pile, brush, and stone dikes, thereby throwing all the water into the main channel and scouring away the shoals; to dredge a channel 100 feet wide and 8 feet deep at low water through the shoal just below Willapa City; and to close Louderback Slough with a pile, brush, and stone dike, in order to compel the currents to scour a channel through the bar above the river mouth. The estimated cost is $31,350.

The amount expended prior to June 30, 1893, was $11,658.72; $6,818.73 in building the dikes at Mailboat Slough, and $5,339.99 in dredging the shoal below Willapa City.

As a result, the channel over the bar below South Bend was deepened and widened to a marked extent. The dredging was not completed.

The amount expended during the year ending June 30, 1894, was $5,842.66 in dredging the Willapa City shoal. There is now a navigable channel across this shoal, but not of the full width proposed.

The appropriations amount to $31,350.

July 1, 1893, balance unexpended	$6,341.28
June 30, 1894, amount expended during fiscal year	5,842.66
July 1, 1894, balance unexpended	498.62
Amount appropriated by act of August 17, 1894	13,350.00
Amount available for fiscal year ending June 30, 1895	13,848.62

(See Appendix U U 12.)

13. Grays Harbor and Chehalis River, Washington.—The Chehalis River is the chief tributary of Grays Harbor. From Montesano to the bay there is usually enough water for coasting vessels, but there are four obstructive shoals. At the head of Grays Harbor the waters divide into a north and a south channel. There is also a middle channel connecting these two. These divisions cause objectionable shoals.

The plan of improvement is to remove the shoals from the river by dredging and closing side sloughs, so as to give a depth of 16 feet at half tide, and to build pile, brush, and stone dikes in the harbor, wholly closing the middle channel, and closing the south channel, with the exception of a gap 1,000 feet wide and about 8 feet deep, with a view to increasing the tidal flow through the north channel and scouring away the bars.

The estimated cost is $150,000.

The amount expended prior to June 30, 1893, was $5,672.97. The works were but fairly started and had not, as yet, had any appreciable effect.

The amount expended during the year ending June 30, 1894, was $43,901.94. The dike closing the south channel was completed, and that closing the middle channel well advanced towards completion. As a result the north channel has been greatly improved, there being an increase of depth of fully 2 feet over the worst shoal.

The appropriations amount to $75,000.

July 1, 1893, balance unexpended	$44,327.03
June 30, 1894, amount expended during fiscal year	43,901.94
July 1, 1894, balance unexpended	425.09
Amount appropriated by act of August 17, 1894	25,000.00
Amount available for fiscal year ending June 30, 1895	25,425.09

Amount (estimated) required for completion of existing project	$75,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	50,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix U U 13.)

14. Chehalis River, Washington.—The possibly navigable portion of the Chehalis River is from Claquato to the mouth, a distance of 90 miles. This may well be considered in three sections.

1. From the mouth to Montesano, a distance of 15 miles, there is a depth of 18 feet at high water. This portion is navigable for coasting vessels.

2. From Montesano to Elma, 16 miles, the river is slightly affected by the tides, and for the most part has water enough for light draft boats, but it is obstructed by snags and fallen trees, and in summer there is a scarcity of water on the bars.

3. Above Elma the river is practically closed during the summer and autumn by snags and a general lack of water; it becomes a succession of pools and shoals. On many of the latter the depth is from 6 to 12 inches only.

The plan of improvement is to remove snags, overhanging trees, jams, drift heaps, shoals, and other obstructions to navigation which may from time to time be found. The cost of this work is indefinite.

The amount expended prior to June 30, 1893, was $10,848.43. As a result the river from Montesano to the mouth was kept in a navigable condition.

The amount expended during the year ending June 30, 1894, was $1,654.73. The river from Montesano to the mouth was cleared of troublesome snags.

The appropriations amount to $13,000.

July 1, 1893, balance unexpended	$2,151.57
June 30, 1894, amount expended during fiscal year	1,654.73
July 1, 1894, balance unexpended	496.84

Amount that can be profitably expended in fiscal year ending June 30, 1896	2,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix U U 14.)

15. Harbor at Olympia, Wash.—Olympia is situated at the head of Budd Inlet, which was badly shoaled up for a distance 8,750 feet from the city. Vessels could reach the city at high tide only. To avoid this inconvenience, long wharves had been built, whose maintenance was very expensive on account of the ravages of the teredo.

The plan of improvement is to dredge a channel 250 feet wide and 12 feet deep at mean lower low water, from the heart of the city at the Fourth street bridge, to deep water in Budd Inlet. The estimated cost is $275,000.

With the money available in 1892, it was proposed to make a beginning by excavating a channel 125 feet wide and 6 feet deep at low water.

The amount expended prior to June 30, 1893, was $2,313.26. As a result the excavation of the reduced channel was well under way.

The amount expended during the year ending June 30, 1894, was $32,669.47.

There is now a navigable channel 7,645 feet long from the Fourth street bridge to deep water. This channel is 105 feet wide for 1,500 feet at its upper end, and 125 feet wide for the rest of its length.

The appropriations amount to $75,000.

July 1, 1893, balance unexpended	$32, 686. 74
June 30, 1894, amount expended during fiscal year	32, 669. 47
July 1, 1894, balance unexpended	17. 27
Amount appropriated by act of August 17, 1894	40, 000. 00
Amount available for fiscal year ending June 30, 1895	40, 017. 27
Amount (estimated) required for completion of existing project	200, 000. 00
Amount that can be profitably expended in fiscal year ending June 30, 1896	100, 000. 00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

(See Appendix U U 15.)

16. Swinomish Slough, Washington.—This is a tidal slough, connecting Saratoga Passage and Skagit Bay on the south with Padilla Bay on the north. It is an important highway for the smaller class of steamboats. In some parts, however, it is shallow and crooked, and the approaches to it are across shallow flats.

The plan of improvement is to dredge a channel 100 feet wide and 4 feet deep from deep water in Saratoga Passage across the Skagit Flats, through the shoals in Swinomish Slough, and across the flats in Padilla Bay to deep water; and to build wattled pile dikes in Skagit and Padilla bays, to direct the tidal currents through the dredged channels.

The estimated cost is $122,000.

The amount expended prior to June 30, 1893, was $393.98. No work beyond a preliminary survey was done.

The amount expended during the year ending June 30, 1894, was $23,380.57.

As a result, there is a channel 6,120 feet long and not less than 100 feet wide and 4 feet deep at mean lower low water across the worst part of the flats at the southern entrance to the slough.

The appropriations amount to $50,000.

July 1, 1893, balance unexpended	$24, 606. 02
June 30, 1894, amount expended during fiscal year	23, 380. 57
July 1, 1894, balance unexpended	1, 225. 45
Amount appropriated by act of August 17, 1894	25, 000. 00
Amount available for fiscal year ending June 30, 1895	26, 225. 45
Amount (estimated) required for completion of existing project	72, 000. 00
Amount that can be profitably expended in fiscal year ending June 30, 1896	72, 000. 00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act o. March 3, 1893.	

(See Appendix U U 16.)

17. Puget Sound, Washington, and its tributary waters.—This work was formerly known as the "Improvement of Skagit, Stillaguamish, Nooksack, Snohomish, and Snoqualmie rivers, Washington."

These rivers in their original condition had enough water for steamer navigation, and were the chief highways of the country, but were obstructed by snags, fallen trees, and log jams. About their mouths were large areas of shallow water, with tortuous channels, often obstructed by drift.

The plan of improvement is to remove snags, logs, fallen trees and other obstructions to navigation. For this purpose a snag boat with complete outfit has been provided, which goes from one river to another as necessity requires. The cost of this work is indefinite.

The amount expended prior to June 30, 1893, was $75,493.86. No permanent results were aimed at or obtained. The constantly recurring obstructions require to be periodically removed. The rivers were kept open and navigation rendered much safer.

The amount expended during the year ending June 30, 1894, was $6,554.32.

A great number of obstructions were removed, and navigation thereby greatly benefited.

The appropriations amount to $98,500.

July 1, 1893, balance unexpended	$9,006.14
June 30, 1894, amount expended during fiscal year	6,554.32
July 1, 1894, balance unexpended	2,451.82
July 1, 1894, outstanding liabilities	50.00
July 1, 1894, balance available	2,401.82
Amount appropriated by act of August 17, 1894	14,000.00
Amount available for fiscal year ending June 30, 1895	16,401.82
Amount that can be profitably expended in fiscal year ending June 30, 1896 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	32,000.00

(See Appendix U U 17.)

IMPROVEMENT OF WILLAMETTE AND LOWER COLUMBIA RIVERS AND THEIR TRIBUTARIES, OREGON AND WASHINGTON.

This district was in the charge of Maj. Thos. H. Handbury, Corps of Engineers, to November 30, 1893, and of Maj. James C. Post, Corps of Engineers, since February 19, 1894, with Lieut. Harry Taylor, Corps of Engineers, under their immediate orders, and in the temporary charge of Lieutenant Taylor from November 30, 1893, to February 19, 1894; Division Engineer, Col. G. H. Mendell, Corps of Engineers.

1. *Mouth of Columbia River, Oregon and Washington.*—The project for this work was adopted in 1884, and contemplated securing and maintaining a channel depth of 30 feet across the bar at the mouth of the river, by the construction of a jetty to extend from the shore near Fort Stevens across Clatsop Spit in the direction of a point about 3 miles south of Cape Disappointment; the ultimate length and height of the work to be determined from the effect produced during construction. The jetty was to be built of rubble and random blocks of stone of large size resting upon mattresses of brush.

Prior to commencing the work of construction in 1885 the channel or channels across the bar varied both in location and depth, the latter being usually from 19 to 21 feet, while the channels, from one to three in number, shifted through nearly 180° from Cape Disappointment to Point Adams.

In March, 1893, the success of the project having been practically assured, the question as to the length and height of the completed jetty was referred to a Board of Engineers who concluded that the existing length of 4½ miles was sufficient, but recommended that it be raised at the inshore end to a height of 12 feet above mean level of the lower low waters, sloping to 10 feet 1⅛ miles from shore, and thence to 4 feet above this datum at the outer end. The Board also recommended the construction of 4 groins or spurs on the channel side to accelerate the accumulation of sands on this side and thus add to the stability of the work.

The amount expended on this improvement to the close of the fiscal year ending June 30, 1893, was $1,498,689.02. Up to this time the jetty had been raised to mean high tide for a distance of 2 miles from shore and beyond this to 4 feet above mean low water, and a straight channel 29 feet deep, and of good width, had been formed across the bar; the width of the 27-foot channel was three-fourths of a mile and that of the 25-foot channel about 1½ miles.

During the year ending June 30, 1894, 115,733.8 tons of rock were added to the jetty which was raised to its completed height for 10,000 feet at the outer end, and for 1,420 feet at the inshore end. Between these portions the height varies from 7.5 above low water at station 150 to 10 feet above low water at station 40. The height for 2,200 feet at the outer end has, however, been reduced from 1 to 4 feet as the result of heavy gales in the latter part of 1893, and the elevated railway for 1,800 feet at the outer end has also been practically destroyed.

Two of the four groins recommended by the Board were constructed during the year.

Soundings taken in May and June, 1894, show that the channel previously formed has been maintained, that the 29-foot channel is somewhat wider, that the 27-foot and 25-foot channels have been increased to a width of 1½ and 2½ miles respectively, and that the shoals on both sides of the jetty have greatly increased both in height and area.

July 1, 1893, balance unexpended	$188,810.98
June 30, 1894, amount expended during fiscal year	170,642.08
July 1, 1894, balance unexpended	18,168.90
July 1, 1894, outstanding liabilities	415.00
July 1, 1894, balance available	17,753.90
Amount appropriated by act of August 17, 1894	338,180.00
Amount available for fiscal year ending June 30, 1895	355,933.90

(See Appendix V V 1.)

2. *Columbia River between Vancouver, Wash., and the mouth of Willamette River.*—The project for this improvement, adopted in 1892, provides for the construction of a low dam across the slough on the Oregon side of Hayden Island to increase the volume of water, and by the additional scour to remove a troublesome bar in the main channel.

The construction of this dam was begun in the latter part of 1892, and was to be completed in January, 1893, but owing to lack of energy and proper management on the part of the contractors, 60 feet of the work was unfinished in April, when the work was submerged by a rise in the Columbia River, and so remained until October; at this time it was found that the incompleted portion of the dam had been carried away, and that the gap had been widened by the washing away of the bank at the island end.

In February, 1894, the contract for this dam was annulled, and a new contract was made for repairing the work so as to provide against further injury until such time as funds should be available for its proper completion.

The amount expended prior to the annulment of the first contract was $25,177.36, leaving $7,822.64 for future work.

Under the contract for repairs a revetment 700 feet long for protection of the bank at the island end of the dam was built in March and April, 1894, and a few piles were driven for extending the dam across the gap.

In April the work was again flooded and so remained to the end of the year.

The officer in charge proposes to submit an estimate for the completion of this improvement after the river has subsided so that the conditions can be definitely ascertained.

July 1, 1893, balance unexpended	$8,094.24
June 30, 1894, amount expended during fiscal year	3,973.41
July 1, 1894, balance unexpended	4,120.83

(See Appendix V V 2.)

3. *Canal at the Cascades, Columbia River, Oregon.*—The object of this improvement, the project for which was adopted in 1877, and subsequently modified in 1880 and 1886, was to provide for navigation between the lower and middle portions of the Columbia River, the plan being to construct a canal at the upper end of the reach of 4½ miles where the river flows through a narrow gorge in the Cascade Mountains, this canal to be 3,000 feet long with a lock to overcome the low-water fall of 24 feet in this distance and to provide for navigation up to a stage of 20 feet above low water, and to remove the rocks from the rapids below so that this portion of the reach might be navigable at all ordinary stages of the river.

The improvement of the rapids had been completed, and considerable progress made in constructing the canal and lock, by hired labor, when, under authority conferred by the river and harbor act of July 13, 1892, which appropriated $326,250 for the work, a contract for completing the improvement was entered into with Messrs. J. G. & I. N. Day.

This contract, which was approved January 24, 1893, provided that the sum appropriated, less engineering expenses, should be earned within one year from date of its approval, and that the amount of each subsequent appropriation should be earned within one year from the date at which it was made. The total liability to be incurred under contract was limited by the act to the sum of $1,419,250 "exclusive of the amount herein and heretofore appropriated."

The sundry civil act of March 3, 1893, appropriated the further sum of $1,239,653 for continuing the improvement, with the proviso that not more than three-fourths of this appropriation should be expended during the fiscal year ending June 30, 1894.

In January, 1894, the time for completing the contract under the appropriations already made was fixed at March 3, 1895, or two years from the date of the last appropriation.

Preliminary work under the contract was begun in March, 1893. Actual construction was begun on the 12th of October following and continued until March 31, 1894, when the lock was submerged, and so remained to the end of the fiscal year. During the year 15,634 cubic yards of concrete and 2,575 cubic yards of stone masonry were laid and 20,785 cubic yards of rock and 35,267 cubic yards of loose material were excavated. Considerable progress was also made in the construction of the lock gates and other metal work required.

The high water of 1876, with reference to which the plans for the canal and lock were prepared, was exceeded 6 feet by the flood of June, 1894; and to prevent submergence by a similar rise in the future it will be necessary to add somewhat to the height of the lock and of the protection works at the head of the canal, and possibly to make other changes, the nature of which can not be definitely stated until the water shall have subsided so that a thorough examination can be made.

In view of these additions and changes, it is probable that the funds available will be insufficient for the entire completion of the canal. No further appropriation is, however, recommended at this time.

The cost of completing this improvement, as estimated in June, 1892, was $1,745,500, of which $1,565,903 has thus far been appropriated.

July 1, 1893, balance unexpended		$1,564,338.33
June 30, 1894, amount expended during fiscal year		330,984.95
July 1, 1894, balance unexpended		1,233,353.38
July 1, 1894, outstanding liabilities	$6,357.87	
July 1, 1894, amount covered by uncompleted contracts	1,202,450.19	
		1,208,808.06
July 1, 1894, balance available		24,545.32

(See Appendix V V 3.)

4. Columbia and Lower Willamette rivers below Portland, Oreg.—The project for improving these rivers, adopted in 1877 and modified in 1891, contemplates securing a channel from Portland to the sea having a low-water depth of 25 feet. Prior to commencing the improvement the low-water depth of the channel was from 10 to 15 feet in the shoalest places. Up to 1891 this depth had been increased to 19 feet by the construction of dams at Swan Island Chute, at Willamette Slough, and at other sloughs in the Willamette River near its mouth; and of a dike at St. Helens and dams at Burke Slough and Martin Slough, in the Columbia River, the effect of these works being aided by dredging and bank protection where most needed.

Since the modification of the project so as to secure a channel depth of 25 feet, dikes have been built by the Port of Portland at St. Johns and Post-Office Bar, in the Willamette River, and at Walkers Island and at Snag Island, Cathlamet Bay, in the Columbia River. This corporation has also dredged the channel at Swan Island and Post-Office Bar, in the Willamette River, and in the Columbia River at the mouth of the Willamette, at St. Helens, at Martins Island, at Walkers Island, and in Cathlamet Bay, removing a total of 255,415 cubic yards of material at these points.

The work done by the United States has consisted in extending the dike at St. Helens, in constructing a dike at Martins Island, in the Columbia River, in dredging the channels of both rivers at various places, and the removal of snags wherever necessary.

In September, 1893, as a result of these improvements, deep-draft vessels were for the first time able to pass fully loaded from the docks in Portland to the sea, thus avoiding the previous heavy expense for lightering.

The net amount expended on this improvement by the United States to the close of the fiscal year ending June 30, 1894, was $987,537.58, of which $765,757.12 was expended under the projects adopted in 1877 and extended in 1891.

During the year ending June 30, 1894, work has been confined to dredging the channels, for the maintenance of which the permanent works have been constructed. This work has been done by the hydraulic dredge specially constructed for the purpose during the previous fiscal year. Dredging has been done at Post-Office Bar, Willamette River, at the mouth of this river, and at Pillow Rock, Snag Island, and Tongue Point, in the Columbia River, a total of 391,000 cubic yards of material being removed at these places.

The officer in charge estimates that the sum of $166,130 can be profitably expended on this improvement in the year ending June 30, 1896.

July 1, 1893, balance unexpended	$42, 827. 42
June 30, 1894, amount expended during fiscal year	38, 073. 29
July 1, 1894, balance unexpended	4, 754. 13
July 1, 1894, outstanding liabilities	28. 80
July 1, 1894, balance available	4, 725. 33
Amount appropriated by act of August 17, 1894	50, 000. 00
Amount available for fiscal year ending June 30, 1895	54, 725. 33
Amount (estimated) required for completion of existing project	166, 130. 00
Amount that can be profitably expended in fiscal year ending June 30, 1896	166, 130. 00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

(See Appendix V V 4.)

5. *Willamette River above Portland, Oreg.*—At the time of the adoption of the present project, in 1878, the mouth of the Yamhill River, 40 miles above Portland, was the head of low-water navigation, with a draft of 2½ feet. Above this point the controlling depth was but 1 foot.

The project of 1878 contemplates the improvement of the river by the removal of obstructions and the construction of dikes to contract the waterway at shoal places, so as to secure a navigable channel for light-draft boats from Portland to Eugene, a distance of 172 miles. This project was extended in 1892 to include the removal of obstructions in the Yamhill River from its mouth to McMinnville, and an allotment of $3,000 for this purpose was included in the appropriation of that year for improving the upper Willamette River.

The amount expended on this project to the close of the fiscal year ending June 30, 1893, was $134,703.21, of which $1,526.22 was for removing obstructions in Yamhill River.

During the past year snagging operations have been continued from Portland to Eugene, on the Willamette River, and to McMinnville, on the Yamhill, and dikes have been built at Luckiamute Bar and at Matheneys Bar, on the Willamette River, greatly improving the navigation at these points.

July 1, 1893, balance unexpended	$18, 951. 65
June 30, 1894, amount expended during fiscal year	15, 525. 40
July 1, 1894, balance unexpended	3, 426. 25
July 1, 1894, outstanding liabilities	150. 22
July 1, 1894, balance available	3, 276. 03
Amount appropriated by act of August 17, 1894	23, 000. 00
Amount available for fiscal year ending June 30, 1895	26, 276. 03
Amount that can be profitably expended in fiscal year ending June 30, 1896	37, 000. 00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

(See Appendix V V 5.)

6. *Cowlitz River, Washington.*—Prior to the adoption of the project for improving this river in 1882, the ruling low-water depth to Toledo, 30 miles above the mouth, was 14 inches.

The project contemplated the removal of sand bars and other obstructions, such as rocks, snags, and overhanging trees, to a point 50 miles from the mouth at a cost of $5,000 for the first year and an annual expenditure of $2,000 for maintenance thereafter. In pursuance of this project work has been done up to Toledo, to which point a low-water depth of 30 inches has been secured, and the usual season of navigation has been increased by one month.

The amount expended on this improvement up to the close of the fiscal year ending June 30, 1893, was $19,727.24.

Work during the current fiscal year has been confined to the maintenance of navigation by the removal of obstructions below Toledo, the amount expended for this purpose being $652.37.

The officer in charge estimates that $3,000 can be profitably expended on this work in the fiscal year 1896.

July 1, 1893, balance unexpended	$2,272.76
June 30, 1894, amount expended during fiscal year	652.37
July 1, 1894, balance unexpended	1,620.39
Amount appropriated by act of August 17, 1894	3,000.00
Amount available for fiscal year ending June 30, 1895	4,620.39
Amount that can be profitably expended in fiscal year ending June 30, 1896 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	3,000.00

(See Appendix V V 6.)

7. *Youngs and Klaskuine rivers, Oregon.*—The improvement of these rivers was sufficiently advanced in 1891 to give a channel depth at high tide of 7 feet from the mouth of Youngs River to the cut-off 7 miles above, and via this river to Kamm's wharf on the Klaskuine River, the total length of the improvement being 9 miles.

The amount expended on this improvement to June 30, 1894, is $1,222.47. No further appropriation is recommended.

July 1, 1893, balance unexpended	$393.21
June 30, 1894, amount expended during fiscal year	15.68
July 1, 1834. balance unexpended	377.53

(See Appendix V V 7.)

8. *Gauging waters of Columbia River, Oregon and Washington.*—The object of this gauging is to obtain data for use in connection with the improvement of the river and to supply information to persons interested in its navigation.

The total amount appropriated for this work ($5,000) had been practically exhausted at the close of the fiscal year ending June 30, 1893, and during the current year but one gauge, that at Astoria, has been in operation, the expenses being paid from the appropriation for improving the mouth of the Columbia River, with which work it is intimately connected.

An estimate of $1,000 for continuing this work is submitted by the officer in charge.

July 1, 1893, balance unexpended	$6.32
June 30, 1894, amount expended during fiscal year	6.32
Amount appropriated by act of August 17, 1894	1,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	1,000.00

(See Appendix V V 8.)

9. ***Examination and plan, by Board of Engineers, for overcoming obstructions to navigation in Columbia River between Three Mile Rapids and Celilo Falls, Oregon and Washington, in compliance with river and harbor act approved July 13, 1892.***—The river and harbor act approved

July 13, 1892, authorized the President to appoint a Board of Engineers, to consist of seven members, three of them to be civilians, to thoroughly examine the obstructions to navigation in the Columbia River from its navigable waters below Three Mile Rapids to its navigable waters above Celilo Falls, and to report such plan, with estimates of cost, "for overcoming or removing said obstructions as in their opinion is most feasible and best adapted to the necessities of commerce, together with a statement as to the usefulness of such improvement to navigation, its relation and value to commerce, and the most desirable location therefor, the cost of construction and of the right of way, including the necessary land therefor, being considered." The sum of $20,000 was appropriated to defray the cost of the examination and the expenses of the Board.

By direction of the President, Col. George H. Mendell, Lieut. Col. Charles R. Suter, Lieut. Col. William R. King, and Maj. Charles J. Allen, Corps of Engineers, and Messrs. William R. Hutton, E. Porter Alexander, and Virgil G. Bogue, civil engineers, were appointed to constitute this Board by orders from the War Department dated July 29, 1892. The report of the Board was rendered under date of April 12, 1893.

The overcoming of the 12 miles of obstructions above Dalles City, 213 miles from the mouth, will, with the completion of the canal at the Cascades, open up through navigation to the Upper Columbia River and to the Snake River. Three constructions to effect the object desired at this point have been considered: (*a*) A portage railway, estimated to cost $454,390, if constructed with a view to minimum expenditure, or $682,301 if constructed with a view to subsequent utilization in constructing a boat railway; (*b*) a boat railway, estimated to cost $2,264,467, or if constructed first as a portage railway available for immediate use and then enlarged to a boat railway, $2,517,063; and (*c*) a canal, estimated to cost not over $4,000,000.

The Board reports that the obstructions to navigation in the Columbia River from the navigable waters below Three Mile Rapids to the navigable waters above Celilo Falls can be overcome in the most feasible, speedy, and economical manner, and in that best adapted to the present necessities of commerce and to its future development, by the construction of a portage railway at an estimated cost of $454,390, and recommends that further development of commerce demanding greater facilities than could be thereby afforded be provided for, when required, by the construction of a canal.

The report was transmitted to Congress and printed in Senate Ex. Doc. No. 7, Fifty-third Congress, first session. A copy is submitted herewith as Appendix V V 9.

EXAMINATIONS, SURVEYS, AND CONTINGENCIES OF RIVERS AND HARBORS.

For examinations, surveys, and contingencies of rivers and harbors an appropriation of $150,000 should be made, as follows:

For examinations, surveys, and contingencies, and for incidental repairs for rivers and harbors, for which there may be no special appropriation; for expenses connected with the inspection of bridges reported as obstructions to navigation, the service of notice required in such cases, and the location of harbor lines as required by the act of September 19, 1890; and for expenses connected with the examinations and reports by officers of the Corps of Engineers and by boards of engineers, upon plans for bridges authorized by law to be constructed, and upon bridge bills, reports on which may be called for by Congress, $150,000.

SUPERVISION OF THE HARBOR OF NEW YORK.

The office of Supervisor of the Harbor of New York was created by act of Congress approved June 29, 1888, entitled "An act to prevent obstructive and injurious deposits within the harbor and adjacent waters of New York City by dumping or otherwise, and to punish and prevent such offenses." This act has been amended by section 3 of the act of August 17, 1894, entitled "An act making appropriations for the construction, repair, and preservation of certain public works on rivers and harbors, and for other purposes," by which amendment the functions and powers of the officer have been greatly enlarged. Additional duties are also conferred on the supervisor by section 2 of the last-named act.

Under the provisions of section 5 of the act of June 29, 1888, a line officer of the Navy is designated to discharge the duties created by the act, under the direction of the Secretary of War. On May 23, 1889, the Secretary of War directed that all communications in connection with these duties should be addressed to him through this office, and on February 1, 1890, he further directed that the powers conferred upon him by the act should be exercised through the Chief of Engineers.

At the beginning of the fiscal year Capt. Frederick Rodgers, U. S. Navy, was supervisor of the harbor, and continued as such until October 2, 1893, when he was relieved by Lieut. Commander Daniel Delehanty, U. S. Navy, who has since discharged the duties of the office.

The report of Lieut. Commander Delehanty, describing the operations in his charge for the fiscal year ending June 30, 1894, is submitted as Appendix W W.

Estimates for the fiscal year ending June 30, 1896.—The estimate of funds required for this service for the fiscal year ending June 30, 1896, is given in the above-mentioned report, as follows:

For pay of inspectors, deputy inspectors, office force, and expenses of office	$20,000
For pay of crew and maintenance of steamer *Nimrod*	10,000
For pay of crew and maintenance of steamer *Argus*	10,000
For pay of crew and maintenance of one steam tug to be purchased or constructed	12,000
For the purchase or construction of one steam tug	45,000
For pay of crew and maintenance of one steam tug to be purchased or constructed	12,000
Total	109,000

MISSISSIPPI RIVER COMMISSION.

The Mississippi River Commission, constituted by act of Congress of June 28, 1879, is in charge of the improvement of Mississippi River between the mouth of Ohio River and the Head of the Passes and of surveys of the entire river.

The commissioners during the past fiscal year were: Col. C. B. Comstock, Corps of Engineers, president; Lieut. Col. Charles R. Suter, Corps of Engineers; Maj. O. H. Ernst, Corps of Engineers (to January 8, 1894), and Lieut. Col. Amos Stickney, Corps of Engineers (from January 30, 1894); Henry L. Whiting, assistant, U. S. Coast and Geodetic Survey; B. M. Harrod; Robert S. Taylor, and Henry Flad.

The report of the commission upon the operations under its chgare during the fiscal year ending June 30, 1894, is submitted as Appendix XX.

Estimates for the fiscal year ending June 30, 1896.—The following estimates of funds required for carrying on the works under its charge for the year ending June 30, 1896, are submitted by the commission:

For improving Mississippi River from Head of the Passes to the mouth of the Ohio River, including salaries, clerical, office, traveling, and miscellaneous expenses of the Mississippi River Commission	$2,665,000
For improving harbors at:	
New Madrid, Mo	75,000
Memphis, Tenn	100,000
Greenville, Miss	200,000
Natchez, Miss., and Vidalia, La	300,000
New Orleans, La	300,000
For improvement at head of Atchafalaya and mouth of Red River, Louisiana	350,000
Total	3,990,000

MISSOURI RIVER COMMISSION.

The Missouri River Commission, constituted by act of Congress of July 5, 1884, is in charge of the improvement and surveys of the Missouri River, below Sioux City, Iowa.

The commissioners during the past fiscal year were: Lieut. Col. Charles R. Suter, Corps of Engineers, president; Maj. A. Mackenzie, Corps of Engineers; Maj. O. H. Ernst, Corps of Engineers (to January 8, 1894), and Maj. Charles J. Allen, Corps of Engineers (from January 30, 1894); G. C. Broadhead, and R. S. Berlin.

The report of the commission upon the operations under its charge for the fiscal year ending June 30, 1894, is submitted as Appendix Y Y.

Estimates for the fiscal year ending June 30, 1896.—The following estimates of funds required for carrying on the works under its charge for the year ending June 30, 1896, are submitted by the commission:

For office and traveling expenses, and salaries of commission	$20,000
Surveys, gauges, physical data, and publications	30,000
Operating snag boat	35,000
Systematic improvement in first reach	665,000
Total	750,000

CALIFORNIA DÉBRIS COMMISSION.

Act of Congress approved March 1, 1893, provided for the establishment of the California Débris Commission, to consist of 3 officers of the Corps of Engineers, appointed by the President, with the concurrence of the Senate, whose functions relate to hydraulic mining in the territory drained by the Sacramento and San Joaquin river systems in California. The Commission is empowered and required to adopt plans for improving the navigation of the rivers in the systems mentioned, to project and construct works for impounding detritus and preventing the deterioration of the rivers from the deposit of hydraulic-mining and other débris, and to devise means and issue permits for resuming and carrying on hydraulic-mining operations under conditions that will not injure other interests in the State. The powers of the Commission, methods of procedure, etc., are prescribed in the act in detail.

The Commissioners appointed by the President May 3, 1893, are Col. G. H. Mendell, Lieut. Col. W. H. H. Benyaurd, and Maj. W. H. Heuer, Corps of Engineers. Lieut. Cassius E. Gillette, Corps of Engineers, has been on duty under orders of the Commission since September 6, 1893.

The first annual report of the Commission, submitted November 15, 1893, and transmitted to Congress and printed in House Ex. Doc. No. 16, Fifty-third Congress, second session, details the operations of the Commission up to that date. A copy of this report is submitted herewith as Appendix Z Z.

February 15, 1894, the Commission submitted a recommendation for an amendment to the act which experience with its actual workings showed to be advisable. This communication was transmitted to Congress and printed in House Ex. Doc. No. 132, Fifty-third Congress, second session.

The report of the Commission for the current year will be submitted when received.

HARBOR LINES.

The existing provisions of United States law relating to the establishment of harbor lines are contained in section 12 of the river and harbor act approved September 19, 1890, as follows:

> SEC. 12. That section 12 of the river and harbor act of August 11, 1888, be amended and reenacted so as to read as follows:
>
> Where it is made manifest to the Secretary of War that the establishment of harbor lines is essential to the preservation and protection of harbors he may, and is hereby authorized to, cause such lines to be established beyond which no piers, wharves, bulkheads, or other works shall be extended or deposits made, except under such regulations as may be prescribed from time to time by him; and any person who shall willfully violate the provisions of this section, or any rule or regulation made by the Secretary of War in pursuance of this section, shall be deemed guilty of a misdemeanor, and on conviction thereof shall be punished by a fine not exceeding $1,000, or imprisonment not exceeding one year, at the discretion of the court, for each offense.

Cases where the establishment of harbor lines at particular harbors has appeared to be essential to their preservation and protection have been considered by the local engineer officers or by Boards of Engineers constituted for the purpose, and reports thereon submitted, with maps indicating the lines recommended for establishment by the War Department; and the reports have been submitted to the Secretary of War with the recommendations of this office. Under the provisions of the law and in this manner harbor lines have been established by the Secretary during the year at the following localities, the correspondence and reports being submitted as appendixes to this report:

Greenport Harbor, New York.—In accordance with requests from local interests, the subject of harbor lines at Greenport, N. Y., was referred to the local engineer, Lieut. Col. Henry M. Robert, Corps of Engineers, for consideration, and his report thereon was submitted December 23, 1893. The lines recommended by him were established by the Secretary of War January 5, 1894. (See Appendix D 28.)

Patchogue River, New York.—At the instance of local interests the subject of establishing harbor lines in Patchogue River was referred to the local officer, Lieut. Col. Henry M. Robert, Corps of Engineers, for consideration; and in pursuance of his recommendations of January 10, 1894, lines at this locality were established by the Secretary of War January 17, 1894. (See Appendix D 29.)

Harlem River, New York.—In order to enable proposed improvements to be made, representatives of the Department of Public Works of New York City on July 11, 1893, applied for modification of the harbor lines north of One hundred and fifty-fifth street on the west bank of Harlem River established by the Secretary of War October 18, 1890. (See

Annual Report Chief of Engineers, 1891, pp. 424 and 958.) The matter was referred to The Board of Engineers on harbor lines for New York Harbor and adjacent waters, consisting of Col. Henry L. Abbot, Col. William P. Craighill, Col. C. B. Comstock, Lieut. Col. Henry M. Robert, and Lieut. Col. G. L. Gillespie, Corps of Engineers, constituted by Special Orders, No. 11, Headquarters Corps of Engineers, January 30, 1889, which submitted a report July 27, 1893, recommending modification of the harbor lines near Washington bridge. The modified lines, as recommended by the Board, were approved by the Secretary of War October 2, 1893. (See Appendix E 14.)

Westchester Creek, New York.—Pursuant to request of local interests the matter of harbor lines along Westchester Creek, New York, was referred to the local engineer, Lieut. Col. G. L. Gillespie, Corps of Engineers, for consideration. His report thereon was submitted June 23, 1894, and the lines recommended by him were established by the Secretary of War June 29, 1894. (See Appendix E 15.)

Shrewsbury River, near Sea Bright, N. J.—In accordance with a request from local navigation interests harbor lines at this locality were, in pursuance of reports of the local officer, Capt. Thos. L. Casey, Corps of Engineers, and the Division Engineer, Col. Henry L. Abbot, Corps of Engineers, established by the Secretary of War February 5, 1894. (See Appendix F 17.)

Delaware River at Philadelphia, Pa., and Camden, N. J.—A Board of Engineers on harbor lines at this locality, consisting of Col. William P. Craighill, Col. C. B. Comstock, and Maj. C. W. Raymond, Corps of Engineers, constituted by Special Orders, No. 20, Headquarters Corps of Engineers, February 25, 1889, submitted report dated December 30, 1893, recommending harbor lines in extension and modification of lines heretofore established; the lines recommended were approved by the Secretary of War January 5, 1894. (See Appendix G 13.)

Ohio River between the upper end of Martins Ferry and the lower end of the city of Bellaire, Ohio.—A Board of Engineers on harbor lines at this locality, consisting of Lieut. Col. Amos Stickney, Maj. D. W. Lockwood, and Lieut. H. E. Waterman, Corps of Engineers, constituted by Special Orders, No. 32, Headquarters Corps of Engineers, May 22, 1891, submitted report dated June 15, 1894. The lines recommended were approved by the Secretary of War June 21, 1894. (See Appendix D D 10.)

Missouri River at Kansas City, Kans., and Kansas City, Mo.—In accordance with requests from the authorities of the States of Kansas and Missouri the consideration of the subject of harbor lines at Kansas City was assigned to the Missouri River Commission. After full investigation of the matter and a public hearing of the parties concerned, the views of the Commission were embodied in a report of September 14, 1893, and the lines recommended were approved by the Secretary of War December 9, 1893. The reports and correspondence are submitted with the annual report of the Missouri River Commission in Appendix Y Y.

Superior Bay, Wisconsin.—Modification of the harbor lines established in Superior Bay September 8, 1890 (see Annual Report, Chief of Engineers, 1891, pp. 426 and 2,515), was requested by the city authorities in March, 1894. The changes proposed were recommended by the local engineer, Maj. Clinton B. Sears, Corps of Engineers, and the Division Engineer, Col. O. M. Poe, Corps of Engineers, and were approved by the Secretary of War March 21, 1894. (See Appendix I I 11.)

Oconto Harbor, Wisconsin.—Harbor lines for this locality were established by the Secretary of War June 23, 1893 (see Annual Report Chief of Engineers, 1893, pp. 462 and 2,784). In laying down these lines on the ground, the local officer, Maj. James F. Gregory, Corps of Engineers, found that lines slightly diverging from them would approximate more nearly to the natural bank and be in every way better, and he accordingly recommended a modification of the approved lines. Modified lines were established by the Secretary of War October 2, 1893. (See Appendix J J 25.)

St. Joseph Harbor, Michigan.—A harbor line for a portion of St. Joseph Harbor was recommended by the local officer, Lieut. Col. G. J. Lydecker, Corps of Engineers, June 1, 1894, in a report on an application for permission to construct a wharf. The line was approved by the Secretary of War June 8, 1894. (See Appendix L L 27.)

Niagara River at Squaw Island, New York.—A Board of Engineers, consisting of Cols. Henry L. Abbot and Cyrus B. Comstock and Capt. Dan C. Kingman, Corps of Engineers, constituted by Special Orders, No. 27, Headquarters, Corps of Engineers, May 29, 1894, to consider and report upon an application for permission to build docks at this locality, submitted a report dated July 16, 1894, recommending the establishment of harbor lines at Squaw Island. The lines were approved by the Secretary of War July 23, 1894. (See Appendix O O 10.)

San Francisco Bay and Oakland Harbor, California.—A Board of Engineers on harbor lines for San Francisco Harbor and adjacent waters, consisting of Col. G. H. Mendell, Lieut. Col. W. H. H. Benyaurd, and Maj. W. H. Heuer, Corps of Engineers, constituted by Special Orders, No. 51, Headquarters Corps of Engineers, October 11, 1886, submitted the following reports:

a. On October 3, 1893, the Board recommended harbor lines for the eastern shore of San Francisco Bay, from Point San Pablo southward in front of Oakland and Alameda; the lines were approved by the Secretary of War October 11, 1893. (See Appendix R R 2.)

b. On September 20, 1893, the Board recommended harbor lines for the estuary of Oakland Harbor; approved by the Secretary of War September 29, 1893. (See Appendix R R 3.)

Napa River at Napa, Cal.—In pursuance of a request from local interests the consideration of harbor lines at Napa was assigned to a Board of Engineers, consisting of Lieut. Col. W. H. H. Benyaurd, Maj. W. H. Heuer, and Lieut. Charles L. Potter, Corps of Engineers, constituted by Special Orders, No. 28, Headquarters Corps of Engineers, July 14, 1893. The Board submitted report October 5, 1893, and the lines recommended were approved by the Secretary of War October 18, 1893. (See Appendix S S 7.)

Everett Harbor, Washington.—At the request of local interests harbor lines were, as recommended in report of October 10, 1893, by the local engineer officer, Capt. Thomas W. Symons, Corps of Engineers, established at Everett by the Secretary of War November 28, 1893. (See Appendix U U 19.)

BRIDGING NAVIGABLE WATERS OF THE UNITED STATES.

Plans and locations of the following bridges, proposed to be erected under the authority of special acts of Congress, have been examined with a view to protection of the interests of navigation, and have been approved by the Secretary of War, as provided by the acts; and the local engineer officers have been furnished with copies of the instruments of approval and drawings showing plans and locations, and charged with the supervision of the construction of the bridges so far as necessary to see that they are built in accordance with the approved plans:

1. *Bridge of the Little Rock Bridge and Terminal Railway Company across Arkansas River at Little Rock, Ark.*—The construction of this bridge was authorized by act of March 2, 1891, amended by act of February 11, 1893. Plans and location were submitted by the company November 10, 1893; approved by the Secretary of War December 7, 1893; copy sent to Capt. Carl F. Palfrey, Corps of Engineers, December 22, 1893.

2. *Bridge of the St. Lawrence Railway Company across St. Lawrence River at Morristown, N. Y.*—The construction of this bridge was authorized by act of February 9, 1893. Plans and location were submitted by the company January 18, 1894; approved by the Secretary of War February 6, 1894; copy sent to Capt. S. S. Leach, Corps of Engineers, February 8, 1894.

3. *Bridge of the South St. Paul Belt Railroad Company across Mississippi River at South St. Paul, Minn.*—The construction of this bridge was authorized by act of Congress approved April 26, 1890, amended by acts of February 24, 1891, February 15, 1892, and February 15, 1893. Plans and location were submitted by the company December 7, 1893, and modified plans January 16, 1894; approved by the Secretary of War February 7, 1894; copy sent to Maj. A. Mackenzie, Corps of Engineers, February 19, 1894.

4. *Bridge of the Lake Shore and Michigan Southern Railroad Company across Calumet River at South Chicago, Ill.*—The reconstruction of this bridge was authorized by act of March 3, 1893. Plans and location were submitted by the company December 23, 1893, and modified plans January 26, 1894; approved by the Secretary of War March 1, 1894; copy sent to Capt. W. L. Marshall, Corps of Engineers, March 14, 1894.

5. *Bridge of the Montgomery Bridge Company across Alabama River near Montgomery, Ala.*—The construction of this bridge was authorized by act of Congress approved March 1, 1893. Plans were submitted February 8, 1894, and modified plans February 23, 1894; approved by the Secretary of War March 27, 1894; copy sent to Maj. F. A. Mahan, Corps of Engineers, March 29, 1894.

6. *Bridge of the city of Red Wing, Minn., across Mississippi River.*—The construction of this bridge was authorized by act of Congress May 12, 1894. Plans and location were submitted May 28, 1894; approved by the Secretary of War June 16, 1894; copy sent to Maj. A. Mackenzie, Corps of Engineers, June 19, 1894.

7. *Bridge of the East Liverpool Bridge Company across Ohio River at East Liverpool, Ohio.*—Plans and location, under the provisions of acts of Congress of December 17, 1872, and February 14, 1883, were submitted May 11, 1894.

These plans were referred to a Board of Officers of the Corps of Engineers as required by section 4 of the act of February 14, 1883, and it was recommended by the Board in its report of June 5, 1894, that the channel span be increased to 650 feet in the clear instead of 500 feet as proposed.

Modified plans were submitted by the company July 2, 1894; approved by the Secretary of War July 2, 1894; copy sent to Lieut. Col. Amos Stickney, Corps of Engineers, July 5, 1894.

8. *Bridge of the Yankton Bridge Company across Missouri River at Yankton, S. Dak.*—The construction of this bridge was authorized by

act of Congress approved June 22, 1892, amended by act of May 28, 1894. Plans and location were received July 23, 1894; approved by the Secretary of War August 3, 1894; copy sent to Capt. H. F. Hodges, Corps of Engineers, August 7, 1894.

9. Bridge of the city of Pittsburg, Pa., across the Monongahela River, at South Twenty-second street.—The construction of this bridge was authorized by act of Congress approved May 7, 1894. Plans and location were submitted May 29, 1894, and modified plans August 3, 1894; approved by the Secretary of War August 21, 1894; copy sent to Capt. R. L. Hoxie, Corps of Engineers, August 23, 1894.

10. Bridge of the Wilmington and Weldon Railroad Company across Contentnia Creek, near Grifton, N. C.—The construction of this bridge was authorized by act of August 23, 1894. Plans and location were submitted by the company through the local engineer officer August 27, 1894; approved by the Secretary of War August 29, 1894; copy sent to Maj. W. S. Stanton, Corps of Engineers, August 30, 1894.

Under the provisions of section 7 of river and harbor act approved September 19, 1890, amended by section 3 of river and harbor act approved July 13, 1892, bridges may be built over navigable waters entirely within the limits of any State, under the authority of legislative enactment of such State, when the plans and locations of the structures are approved by the Secretary of War. Plans and locations of the following bridges proposed to be erected under these provisions have been examined, with a view to protection of the interests of navigation, and have been approved by the Secretary of War; and the local engineer officers have been furnished with copies of the drawings and instruments of approval, and charged with the supervision of construction of the bridges so far as necessary to see that they are built in accordance with the approved plans.

1. Bridge of the city of Tacoma, Wash., across the ship channel through that city.—Plan and location were submitted June 29, 1893; approved by the Secretary of War September 29, 1893; copy sent to Capt. T. W. Symons, Corps of Engineers, October 4, 1893.

Upon application of the city, October 30, 1893, the Secretary of War, November 15, 1893, authorized certain modification of the specified conditions respecting the location of piers.

2. Bridge of Orange County, Tex., across Cow Bayou, about 6 miles above its confluence with Sabine River.—Plans and location of this bridge were approved by the Secretary of War, July 6, 1893 (see Annual Report Chief of Engineers, 1893, p. 470); September 23, 1893, the county submitted plans for a bridge of different type from and in lieu of that originally contemplated; approved by the Secretary of War, October 6, 1893; copy of instrument sent to Maj. A. M. Miller, Corps of Engineers, October 10, 1893.

3. Bridge of the Savannah, Florida and Western Railway Company across Hillsborough River at Tampa, Fla.—Plans and location were submitted July 31, 1893; approved by the Secretary of War October 23, 1893; copy sent to Lieut. A. M. D'Armit, Corps of Engineers, October 25, 1893.

4. Bridges of the Mobile and Dauphin Island Railroad and Harbor Company across Dog and Fowl rivers, Alabama.—Plans and location for this bridge were submitted September 23, 1893; approved by the Secretary of War November 3, 1893; copy sent to Maj. A. N. Damrell, Corps of Engineers, November 6, 1893.

5. Bridge of Brasoria County Tex., across San Bernard River at Churchills Ferry.—Plans and location of this bridge were submitted

September 11, 1893; approved by the Secretary of War November 7, 1893; copy sent to Maj. A. M. Miller, Corps of Engineers, November 8, 1893. The bridge has been completed in accordance with the approved plans.

6. *Bridges of the city of Chicago at Van Buren street and the Metropolitan West Side Elevated Railroad Company between Jackson and Van Buren streets, across South Branch of Chicago River, Chicago, Ill.*—Plans and locations for the proposed bridges were submitted conjointly by the city and railroad company July 26, 1893. Protest having been made against their construction, a hearing of the parties interested was held before the local officer, Capt. W. L. Marshall, Corps of Engineers; and in accordance with his recommendations, the Secretary of War on November 16, 1893, authorized the reconstruction of the city bridge at Van Buren street, and the construction, upon removal of obstructions caused by the existing Van Buren street bridge, of the railroad bridge between Jackson and Van Buren streets. Copy of the approval was sent to Captain Marshall November 20, 1893.

Application for approval of a slight change in the approved location of the piers of the railroad bridge was made by the railroad company March 17, 1894; approved by the Secretary of War March 27, 1894; copy sent to Captain Marshall March 29, 1894.

7. *Bridge of Knox County, Tenn., across Holston River at Boyds Ferry, near Knoxville.*—Plans for this bridge were approved by the Secretary of War August 2, 1893 (see Annual Report Chief of Engineers, 1893, p. 470). Application for modification of the approved plans was submitted by the bridge commissioners of Knox County November 18, 1893; the modification was approved by the Secretary of War November 29, 1893; copy sent to Capt. John Biddle, Corps of Engineers, December 2, 1893.

8. *Bridge of the Wisconsin Central Railroad Company across Wolf River at Gills Landing, Wisconsin.*—Plans and location were submitted November 22, 1893, for the construction of a new bridge to replace the existing one at this point; approved by the Secretary of War December 7, 1893; copy sent to Maj. James F. Gregory, Corps of Engineers, December 9, 1893.

9. *Bridge of the city of Kaukauna, Wis., across Fox River and canal.*—Plans and location were submitted November 9, 1893; approved by the Secretary of War December 11, 1893; copy sent to Maj. James F. Gregory, Corps of Engineers, December 13, 1893.

The bridge has been completed in accordance with the approved plans.

10. *Bridge of the city of Manistee, Mich., across Manistee River at Smith street.*—Plans and location were submitted August 28, 1893, and approved by the Secretary of War September 27, 1893.

Application for approval of a slight change in the approved locations of the piers was made by the Mayor January 6, 1894, and approved by the Secretary of War January 18, 1894. Copies of the instruments of approval were sent to Maj. William Ludlow and Lieut. Col. G. J. Lydecker, Corps of Engineers, September 29, 1893, and January 20, 1894, respectively.

11. *Bridge of the city of De Pere, Wis., across Fox River and canal.*—Plans and location were submitted by the city January 2, 1894, for rebuilding the existing structure at this place; approved by the Secretary of War February 1, 1894; copy sent to Maj. James F. Gregory, Corps of Engineers, February 3, 1894.

12. *Bridge of the town of Hempstead, Queens County, N. Y., across Nortons Creek.*—Plans and location were submitted January 23, 1894;

approved by the Secretary of War February 6, 1894; copy sent to Lieut. Col. H. M. Robert, Corps of Engineers, February 9, 1894. The bridge has been completed in accordance with the approved plans.

13. *Bridge of Brazoria County, Tex., across Brazos River at Columbia.*—Plans and location of this bridge were received January 20, 1894; approved by the Secretary of War February 12, 1894; copy sent to Maj. A. M. Miller, Corps of Engineers, February 14, 1894.

14. *Bridge of the Creighton Bridge Company across Allegheny River at Creighton, Pa.*—Plans and location were submitted December 1, 1893, and modified plans January 20, 1894; approved by the Secretary of War February 27, 1894; copy sent to Capt. R. L. Hoxie, Corps of Engineers, March 1, 1894.

15. *Bridge of the city of Houston, Tex., across Buffalo Bayou.*—Plans and location were submitted February 14, 1894; approved by the Secretary of War March 12, 1894; copy sent to Maj. A. M. Miller, Corps of Engineers, March 14, 1894.

16. *Bridge of the Sea Shore Road Company across Youngs Bay, Oregon.*—Plan and location were submitted January 9, 1894; approved by the Secretary of War March 14, 1894; copy sent to Maj. J. C. Post, Corps of Engineers, March 17, 1894.

17. *Bridge of the Washington and Chesapeake Beach Railway Company across Patuxent River at Mount Calvert, Md.*—Plan and location of this bridge were approved by the Secretary of War April 26, 1892. (See Annual Report, Chief of Engineers, 1892, p. 405). On March 30, 1894, the company submitted plans providing for slight modification in construction of the draw and center pier; approved by the Secretary of War April 3, 1894; copy sent to Maj. C. E. L. B. Davis, Corps of Engineers, April 4, 1894.

18. *Bridge of Clarke County, Wash., across East Fork of Lewis River at La Center.*—Plans and location were submitted January 29, 1894; approved by the Secretary of War April 11, 1894; copy sent to Maj. J. C. Post, Corps of Engineers, April 12, 1894.

19. *Bridge of the Kensington Rapid Transit Bridge Company across Allegheny River below Tarentum, Pa.*—Plans and location were submitted by the company March 28, 1894, and modified plans April 14, 1894; approved by the Secretary of War April 28, 1894; copy sent to Capt. R. L. Hoxie, Corps of Engineers, May 1, 1894.

20. *Bridge of the Ahnapee and Western Railway Company across Sturgeon Bay, Wisconsin.*—Plans and location were submitted April 20, 1894; approved by the Secretary of War April 30, 1894; copy sent to Maj. J. F. Gregory, Corps of Engineers, June 2, 1894.

21. *Bridge of the city of Boston, Mass., across Chelsea Creek at Chelsea street.*—Plans and location for rebuilding the existing structure at this point were submitted April 2, 1894; approved by the Secretary of War May 7, 1894: copy sent to Lieut. Col. S. M. Mansfield, Corps of Engineers, May 9, 1894.

22. *Bridge of Passaic and Bergen counties, N. J., across Passaic River at Passaic.*—Plans and location were submitted May 11, 1894, and modified plans May 24, 1894; approved by the Secretary of War May 31, 1894; copy sent to Capt. Thomas L. Casey, Corps of Engineers, June 2, 1894.

23. *Bridge of Northwestern Elevated Railroad Company across Chicago River east of Wells street, Chicago, Ill.*—Plans and location were submitted April 21, 1894, and modified plans May 24, 1894; approved by the Secretary of War June 2, 1894; copy sent to Capt. W. L. Marshall, Corps of Engineers, June 2, 1894.

24. *Bridge of the Silver Springs, Ocala and Gulf Railroad Company across Withlacoochee River at Dunnellon, Fla.*—Plans for a bridge to replace the existing structure were submitted June 2, 1894; approved by the Secretary of War June 14, 1894; copy sent to Maj. T. H. Handbury, Corps of Engineers, June 16, 1894.

25. *Bridge of the Port Royal and Augusta Railway Company across Savannah River near Augusta, Ga.*—Under date of May 30, 1894, plans were submitted for the erection of certain structures for the protection of this bridge and for training the channel through the draw span; approved by the Secretary of War June 20, 1894; copy sent to Capt. O. M. Carter, Corps of Engineers, June 22, 1894.

26. *Bridge of the town of Kaukauna, Wis., across the lock of the Government Canal at Little Chute, Wis.*—Plans and location were submitted May 3, 1894; approved by the Secretary of War June 22, 1894; copy sent to Maj. James F. Gregory, Corps of Engineers, June 25, 1894.

27. *Bridge of the city of Philadelphia, Pa., across Pennypack Creek, at Torresdale avenue.*—Plans and location were submitted June 13, 1894; approved by the Secretary of War June 23, 1894; copy sent to Maj. C. W. Raymond, Corps of Engineers, June 25, 1894.

28. *Bridge of the West Norfolk and Port Norfolk Drawbridge Company across Western Branch of Elizabeth River, between West Norfolk and Port Norfolk, Va.*—Plans and location were submitted February 26, 1894, and modified plans June 9, 1894; approved by the Secretary of War June 23, 1894; copy sent to Lieut. Edward Burr, Corps of Engineers, June 25, 1894.

29. *Bridge of Kanawha County, W. Va., across Elk River at Clendennin.*—Plans and location were submitted February 12, 1894, and modified plans were received June 16, 1894; approved by the Secretary of War June 23, 1894; copy sent to Col. William P. Craighill, Corps of Engineers, June 25, 1894.

30. *Bridge of Bristol County, Mass., across the East Branch of Westport River at Westport Point, Mass.*—Plans and location were submitted April 21, 1894; approved by the Secretary of War July 5, 1894; copy sent to Capt. W. H. Bixby, Corps of Engineers, July 7, 1894.

31. *Bridge of Dorchester County, Md., across Cambridge Harbor at Cambridge, Md.*—Plans for the alteration of the existing structure were submitted June 27, 1894; approved by the Secretary of War July 11, 1894; copy sent to William F. Smith, U. S. agent, major of engineers, U. S. Army, retired, July 25, 1894.

32. *Bridge of the Lake Street Elevated Railroad Company across Chicago River east of Wells street bridge, Chicago, Ill.*—Plans and location were submitted June 1, 1894: approved by the Secrerary of War July 13, 1894; copy sent to Capt. W. L. Marshall, Corps of Engineers, July 17, 1894.

33. *Bridge of Snohomish County, Wash., across Stillaquamish River, Washington.*—Plans and location were submitted June 2, 1894; approved by the Secretary of War July 13, 1894; copy sent to Capt. T. W. Symons, Corps of Engineers, July 17, 1894.

34. *Bridge of Adrien Gonsoulin across Bayou Teche near Loreauville, La.*—Plans and location were submitted June 20, 1894; approved by the Secretary of War July 26, 1894; copy sent to Maj. J. B. Quinn, Corps of Engineers, July 27, 1894.

35. *Bridge of Wahkiakum County, Wash, across Skamokawa Creek, Washington.*—Plans and location were submitted May 30, 1894; approved by the Secretary of War July 30, 1894; copy sent to Maj. J. C. Post, Corps of Engineers, August 1, 1894.

36. *Bridge of the New York Central and Hudson River Railroad Company across Spuyten Duyvil Creek, New York.*—Plans for the reconstruction of the existing bridge were submitted by the company May 31, 1894; approved by the Secretary of War August 28, 1894; copy sent to Lieut. Robert McGregor, Corps of Engineers, August 30, 1894.

37. *Bridge of Warren County, Miss., across Big Black River at Hankinsons Ferry, Miss.*—Plans were submitted August 14, 1894; approved by the Secretary of War August 30, 1894; copy sent to Capt. J. H. Willard, Corps of Engineers, August 31, 1894.

Under the provisions of sections 4 and 5 of the river and harbor act approved September 19, 1890, relating to bridges obstructing navigation, plans for alteration of the following bridges so as to render navigation unobstructed have been examined and approved by the Secretary of War; and the local engineer officers have been furnished with copies of the plans and instruments of approval and charged with supervision of the work of alteration so far as necessary to see that the approved plans are complied with:

1. *Bridge of the Mobile and Birmingham Railway Company across Three Mile Creek, near Mobile, Ala.*—Complaint having been made that this bridge was an obstruction to navigation, and proceedings having been instituted against it, the railroad company on November 2, 1893, submitted plan for alteration of the bridge by providing it with a suitable draw opening; approved by the Secretary of War November 29, 1893, under condition that the existing obstruction should be removed by February 11, 1894; copy sent to Maj. A. N. Damrell, Corps of Engineers, December 2, 1893. The time for completing the work was subsequently extended by the Secretary of War to May 11, and to July 31, 1894.

2. *Bridge of the Baltimore and Ohio Railroad Company across Calumet River at South Chicago, Ill.*—Plans and location for a more desirable bridge at this point, to replace the existing structure, were submitted by the company December 23, 1893, and modified plans January 26, 1894; approved by the Secretary of War March 1, 1894; copy sent to Capt. W. L. Marshall, Corps of Engineers, March 14, 1894.

Authority to construct *a temporary bridge, by Sussex County, Del., across the canal now being constructed by the United States between Chincoteague and Delaware bays at the crossing of the highway to Henlopen City*, applied for June 8, 1894, was granted by the Secretary of War June 20, 1894, by revocable license. A copy was sent to the local engineer, William F. Smith, United States agent, June 22, 1894.

The license was revoked by the Secretary of War September 8, 1894.

BRIDGES OBSTRUCTING NAVIGATION.

Under the requirements of sections 4 and 5 of the river and harbor act approved September 19, 1890, the Secretary of War notified the persons, corporations, or associations owning or controlling certain bridges obstructing navigation, after giving them a reasonable opportunity to be heard, to so alter said bridges as to render navigation through or under them reasonably free, easy, and unobstructed, specifying in the notice the alterations required to be made, and prescribing a reasonable time in which to make them, as follows:

1. *Bridge across the Merrimac River, between Haverhill and Bradford, Mass.*—Notices dated August 18, 1893, served on the Mayor of the city of Haverhill and chairman selectmen town of Bradford, Mass., September 6, 1893. Alteration required: The construction of a fender

about the pivot pier, similar to the fenders at the draws of other bridges across this river, which shall extend up and down the river to a distance at least equal to the overhang of the draw when open and sufficiently wide to protect the rigging of a passing vessel from entanglement with the overhanging sidewalks, and also timber fenders along the adjacent piers. Alteration to be made and completed on or before October 1, 1894.

2. *Bridge across the Trent River at Newbern, N. C.*—Notice dated September 8, 1893, served on W. S. Chadwick, president of the Atlantic and North Carolina Railroad Company, October 26, 1893. Alterations required: (1) Move the draw to mid channel; (2) Make the direction of the draw piers and axis of the draw opening parallel with the mid-channel line and the prevailing direction of the strongest currents; (3) increase the clear width of the draw opening to 45 feet; (4) place suitable fender piles in the customary manner at each end of the new draw piers to facilitate the approach and entrance to the draw by vessels and rafts. Alterations to be made and completed on or before September 1, 1894. The time was subsequently extended to April 1, 1895.

3. *Bridge across the cove at Sullivans Island, South Carolina.*—Notice dated February 20, 1894, served on the president of the Mount Pleasant and Seaview Railroad Company March 17, 1894. Alteration required: To remove the piles numbered 1 to 8, inclusive, on the attached drawing, and the swing bridge from the center pier. Alteration to be made and completed on or before thirty days from the date of service of notice. Time subsequently extended sixty days.

4. *Highway bridge across Potsburg Creek, Florida.*—Notice dated April 20, 1894, served on the chairman of the board of county commissioners, St. Johns County, Fla., April 26, 1894. Alteration required: To provide the bridge with an open span having a clear width of 27 feet, with a middle height of 12 feet above high water, and side heights of not less than 10 feet above high water. Alteration to be made and completed on or before June 1, 1894. Alteration has been made and completed.

5. *Bridge across the Ocklochonee River at McIntyre, Florida.*—Notice dated April 20, 1894, served on the president of the Carabelle, Tallahassee and Georgia Railroad Company April 30, 1894. Alteration required: To remove the row of piles from the center of one of the open spans, so as to afford a clear opening of 32 feet. Alteration to be made and completed on or before June 1, 1894. Notification has been received that the work has been done.

OCCUPANCY OF AND INJURY TO PUBLIC WORKS BY CORPORATIONS AND INDIVIDUALS.

Under the requirements of section 2 of the river and harbor act approved July 5, 1884, and section 4 of the river and harbor act approved August 5, 1886, there are submitted herewith reports of officers in charge of river and harbor districts of instances in which piers, breakwaters, or other works built by the United States in aid of commerce or navigation are used, occupied, or injured by corporations or individuals. (See Appendix A A A.)

MISCELLANEOUS.

[Public works not provided for in acts making appropriations for the construction, repair, and preservation of works on rivers and harbors.]

MAINTENANCE AND REPAIR OF WASHINGTON AQUEDUCT—INCREASING THE WATER SUPPLY, DISTRICT OF COLUMBIA—ERECTION OF FISHWAYS AT GREAT FALLS.

Officer in charge, Col. George H. Elliot, Corps of Engineers.

1. *Washington Aqueduct.*—Advantage was taken of the very low condition of the Potomac in August to replace the riprap back of the dam that had been carried away by ice in the two preceding winters.

On December 21 there was introduced into the Senate of the United States and referred to the Committee on the District of Columbia a bill entitled "A bill to amend an act approved July 15, 1882, entitled 'An act to increase the water supply of the city of Washington, and for other purposes.'" The bill provided for the acquirement by the United States by the right of eminent domain or otherwise of so much of the land and water rights at Great Falls as might be deemed necessary for the present and future water supply of the District of Columbia. It also provided for securing by the United States to its coowners in the land and water rights at the falls, by contracts, the right to use and the facilities for using the remainder of the flow of the river, and for the ascertainment and payment of damages for the land and water rights taken under the act of 1882. On reference of the bill to the engineer officer in charge of the Washington Aqueduct, and after a careful examination of the subject, he proposed several important amendments, which, on being approved by the Chief of Engineers and the Secretary of War, were adopted by the Senate Committee on the District of Columbia, and the bill as amended is now pending in Congress.

It provides for the securing, by the right of eminent domain, of all the water and water rights at Great Falls, to the end that the United States, for itself and the District of Columbia, may not only increase from time to time, without limit and without further controversy with its riparian coowners, the supply for ordinary purposes, but may utilize the remainder for power to be used in the generation of electricity for the lighting of the public buildings, the public grounds and streets of Washington, for the pumping of water to the higher levels of the city, and for other public purposes.

As soon (July 17) as the lands required for that part of the project for the improvement of the Dalecarlia receiving reservoir—that was designed to be executed by means of the appropriation of $60,000 in the act of Congress of March 3, 1893—had been acquired and the necessary temporary buildings had been erected, the execution of this part of the project, viz, the excavation and lining of the main drainage tunnel under Dalecarlia Hill and the excavation and lining of a receiving shaft in the valley of Little Falls Branch, was commenced.

The major part of the work was carried on by three shifts working night and day, and it was completed on June 20. There remains to be done the tunnel through the hill that lies to the eastward of Little Falls Branch; the permanent dams across Little Falls Branch, Mill Creek, and East Creek, and the open channels between these streams, and the work can be completed in the next fiscal year if the remainder of the amount authorized by Congress for this work—$90,000—be appropriated.

For want of funds nothing has been done during the last fiscal year in the work of removal of the deposits in the conduit, which an inspection of its interior in September, 1891, by the officer in charge found to amount to about 15,000 cubic yards. The deposits interfere with the full flow of the conduit, and, with the want of height of the dam at Great Falls—although not to so great a degree as the latter—are a cause of a deficiency of water in the distributing reservoir, which in turn gives rise in summer to complaints to the District Commissioners from householders in the city. Extensive repairs were made on the macadam pavement of the Conduit road between the top of Foxhall road and the upper end of the distributing reservoir, and a large quantity of flint rock has been procured and crushed for the repair of that portion of the road that is between the distributing reservoir and Culvert No. 24.

There have been no breaks in the United States mains during the last fiscal year, and the only labor expended upon them has been in the driving up of the lead in a few of the joints where it was found necessary, and in providing against the bursting in freezing weather of the small valves designed for admitting air while emptying the 48-inch and 30-inch mains that were laid under the provisions of the act of March 2, 1889.

By direction of the Secretary of War, notices were served by the officer in charge on five encroaching owners of lands along the Conduit road to terminate their encroachments on the United States lands within specified times and under specified penalties.

The wrought-iron riveted girder bridge north of the M street highway bridge, which carries the 48-inch main across Rock Creek, was thoroughly tightened up, and it and the Pennsylvania avenue aqueduct bridge were painted. Both the bridges are in excellent condition.

In the list of estimates of the officer in charge for the fiscal year ending June 30, 1896, will be found estimates for the remainder of the amount contemplated by Congress in its act approved March 3, 1893, for the improvement of the Dalecarlia receiving reservoir and for raising the height of the dam at Great Falls. Especial attention is invited to the urgent reasons for an early appropriation for the latter purpose, to be found in the report of that officer.

The officer in charge renews his estimates for several necessary works, as follows: Removing the accumulation of deposits in the conduit; lowering the height of the cross dam at the distributing reservoir; protecting the inlet to the aqueduct at Great Falls; the purchase or condemnation of a site for a storage yard; cleaning out the distributing reservoir; storehouse at Great Falls; commencing the widening of the macadam pavement of the Conduit road; raising of the heights of the masonry casings of the conduit manholes; inserting air valves and blow-off valves in the 36-inch and 30-inch mains, and replacing in stone the decaying wooden bridge over the channel from the spillway at the Dalecarlia receiving reservoir.

Full explanations of the foregoing estimates, all of which have had my approval, may be found in the report of the officer in charge. This officer also suggests an important provision of law respecting appropriations for the maintenance and repair of the Washington Aqueduct that is required to make them available until expended, like appropriations for river and harbor works, light-houses, etc., and not fiscal year appropriations as at present, and he states the reasons therefor, as well as for a small increase of $1,000 to the general appropriation for the preservation and repair of the aqueduct and its accessory works.

Both of these are of great importance, and the recommendations of the officer in charge in respect to them are concurred in.

Washington Aqueduct.

July 1, 1893, balance unexpended	$805.01
Amount appropriated by act approved March 3, 1893	20,000.00
	20,805.01
June 30, 1894, amount expended during fiscal year	20,267.78
July 1, 1894, balance unexpended	537.23
July 1, 1894, outstanding liabilities	536.82
July 1, 1894, balance available	.41
Amount that can be profitably expended in fiscal year ending June 30, 1896	21,000.00

Improving Dalecarlia Receiving Reservoir.

Amount appropriated by act approved March 3, 1893	$60,000.00
June 30, 1894, amount expended during fiscal year	58,961.95
July 1, 1894, balance unexpended	1,038.05
July 1, 1894, outstanding liabilities	1,000.95
July 1, 1894, balance available	37.10

The estimates of the officer in charge for the fiscal year ending June 30, 1896, are as follows:

For completing the improvement of the Dalecarlia receiving reservoir by the works required for cutting off the drainage into it of polluted water and sewage from the surrounding country, for completing the purchase or condemnation of the small amount of land required for the purpose, and the excavation necessary at the head of the reservoir	$37,500
For raising the height of the dam at Great Falls, together with the cost of such other work as may be found necessary in connection therewith, including the cost of strengthening the conduit, and for damages on acount of flooding of land and other damages	125,000
For commencing the widening of the macadam pavement of the Conduit road to 30 feet by widening that portion of the road that lies between the lower end of the distributing reservoir and the Dalecarlia receiving reservoir; widening the road and the embankments over the culverts on the line of the aqueduct where necessary for this purpose; making the necessary changes in the drainage, and the planting of shade trees.	34,500
For lowering the height of the cross dam at the distributing reservoir	12,500
For protecting the inlet to the aqueduct at Great Falls	5,000
For purchase or condemnation of a site for a storage yard	10,000
For cleaning out the distributing reservoir	13,825
For storehouse at Great Falls	1,500
For inserting air valves and blow-off valves in the 36 inch and 30-inch mains	6,250
For removing the accumulation of deposits in the conduit	14,000
For rebuilding in stone the bridge over the channel from the spillway at the Dalecarlia receiving reservoir	18,000
For raising the height of the masonry casings of the conduit manholes where necessary	600
For maintenance and repair of the aqueduct, and the reservoirs, mains, roads, etc., connected therewith	21,000

(See Appendix B B B 1.)

2. *Increasing the water supply of Washington, D. C.*—All operations on this project are suspended, and no work has been done under it during the year. By reason of the improvement and change of grade of Champlain avenue by the District government it was found necessary to place a timber crib 8 feet high around the Champlain avenue

shaft of the tunnel to the new reservoir near Howard University. The sum of $470.90 was paid to Thomas Ready for a parcel of land between the distributing reservoir and the intersection of the Conduit and Foxhall roads, conveyed by said Ready and wife to the United States. This payment was specially authorized in the provisions for the Washington Aqueduct in the act of Congress approved March 3, 1893. A watchman has been employed during the year at the new reservoir. His duties have included the guarding of the stone at the mouths of all the shafts except the one at Foundry Branch, which is under the care of the watchman at the distributing reservoir.

July 1, 1893, balance unexpended on all items of appropriation	$429,345.28
June 30, 1894, amount expended during the year	1,706.03
July 1, 1894, balance unexpended and available	427,639.25

No estimate for further appropriation is submitted.

(See Appendix B B B 2.)

3. *Erection of fishways at Great Falls.*—Under a ruling concerning the act of July 15, 1882, providing for the construction of these fishways, the Secretary of War decided that the engineer officer in charge should be held responsible only for the proper protection of the aqueduct dam at Great Falls and the disbursement of the funds appropriated, the Commissioner of Fish and Fisheries being responsible under the act for the plans and specifications of the fishways and their execution. No work has been done on the fishways during the last fiscal year for want of funds. Sections 2, 3, 4, 5, and 6 and a portion of the permanent dam have been completed. There remains to be constructed the remainder of this dam and section 1. The Commissioner of Fish and Fisheries is of the opinion that an additional sum of $7,890 will be required to complete the work, and requests that the estimate for it contained in the last annual report be submitted. It was not acted on by Congress, and it is again submitted.

July 1, 1893, balance unexpended	$4,501.29
June 30, 1894, amount expended during fiscal year	4,466.34
July 1, 1894, balance unexpended	34.95
July 1, 1894, outstanding liabilities	2.93
July 1, 1894, balance available	32.02
Amount deemed necessary by the Commissioner of Fish and Fisheries for the completion of the work	7,890.00

(See Appendix B B B 3.)

IMPROVEMENT AND CARE OF PUBLIC BUILDINGS AND GROUNDS, AND CARE AND MAINTENANCE OF THE WASHINGTON MONUMENT, IN THE DISTRICT OF COLUMBIA.

Officer in charge, Col. John M. Wilson, lieutenant colonel, Corps of Engineers, with additional Second Lieut. John S. Sewell, Corps of Engineers, under his immediate orders from July 22, 1893, to January 6, 1894, and from March 27, 1894, until June 30, 1894.

Careful and accurate calculations have been made to determine the strength of the floors of the various buildings occupied as offices by the War Department, except the State, War, and Navy building, and monthly inspections have been made in connection with the care, repair, and safety of these buildings.

Under the terms of the act of Congress approved September 7, 1893, Ford's Theater building was repaired and restored by December 31, 1894, to the condition in which it was prior to the accident of June 9, 1893.

Under the terms of the act of March 12, 1894, the same building was repaired and strengthened in accordance with the recommendations of the board of engineer officers submitted to Congress in House Ex. Doc. No. 61, Fifty-third Congress, second session.

The work of strengthening, repairing, etc., was so nearly completed on June 30, 1894, that portions of the building were then available for desk room for clerks and for storage purposes.

Minor repairs for the purpose of strengthening floors, etc., were made to several of the buildings occupied by the War Department as offices, and at the close of the fiscal year all of these buildings were believed by the officer in charge to be in safe condition for the purposes for which they were then being used.

The Executive Mansion has received the usual care, and such improvements have been made as the funds available would admit; some of the interior walls have been redecorated and rooms refurnished.

New furniture, matting, carpets, curtains, etc., have been supplied from time to time when necessary.

The conservatory and greenhouses were all overhauled and repairs of various kinds made.

Every effort has been made to maintain the Washington Monument and its machinery in good condition, and to continue the improvement and ornamentation of the adjacent grounds.

All boilers and machinery have been carefully overhauled and cleaned, and the work of repainting the ironwork of the interior of the monument has been continued.

The elevator receives the most careful attention, being constantly inspected by experts, and it is believed to be as safe as it is in the power of man to make it.

There were 148,917 visitors to the top of the shaft during the year, making a total of 938,419 persons who have made the ascent since the monument was opened to the public in October, 1888.

The improvement of the Monument grounds has been continued, plank walks constructed, new water pipe introduced, flower beds planted, etc.

At the propagating gardens and nurseries extensive repairs were made to the greenhouses, about 400,000 plants propagated for use in the public parks, shops and storehouses repaired, and a large number of cuttings of flowering shrubs planted.

The asphalt roads and walks in Smithsonian and Judiciary parks have been extended, and repairs made to the asphalt walks in Lafayette, Franklin, and Farragut parks and Du Pont Circle.

The officer in charge invites attention to the propriety of erecting a separate building for office purposes for the President of the United States.

He also recommends the extension of the electric-light system to include the Monument grounds, Lafayette and Franklin parks; the improvement of several reservations; the construction of an asphalt walk on the border of the ellipse south of the Executive Mansion, and the overhauling of the pipe line which supplies the Capitol with pure water from the spring located within the new reservoir.

Attention is invited to the detailed report of the officer in charge, and to his estimates and recommendations for the fiscal year ending June 30, 1896.

His estimates are as follows:

For improvement and care of public buildings and grounds in charge of the Chief of Engineers		$245,621.40
For compensation of persons employed on public buildings and grounds		61,420.00
For replacing the overhead system of telegraph wires with duplicate six-conductor underground cable, and for care and repair of existing lines		28,100.00
For contingent and incidental expenses of public buildings and grounds		500.00
For care of Washington Monument and maintenance of elevator:		
Salaries of employés	$9,060.00	
Fuel, lights, contingencies, etc	3,000.00	
		12,060.00
Total		347,701.40

(See Appendix C C C.)

NORTHERN AND NORTHWESTERN LAKES—SURVEYS—CORRECTING ENGRAVED PLATES—PRINTING AND ISSUING OF CHARTS.

Surveys on the Great Lakes by engineer officers were made more than two generations ago. There are upon the files of this office maps of localities made by such officers in the years 1817, 1819, 1824, 1826, 1827, and many of later dates up to the present time.

Up to 1841 these surveys were in connection with improvement of the various harbors and of rivers tributary to the lakes. The needs of navigation demanding more than surveys of disconnected localities, the "Survey of the Northern and Northwestern Lakes" as a connected whole was commenced under an appropriation made March 3, 1841, of $15,000 for a "hydrographic survey of the coasts of the Northern and Northwestern Lakes of the United States."

This work was naturally assigned to the War Department, as its officers had theretofore been engaged in making local surveys and had charge of the works of improvement then in progress, and had been so engaged for a number of years; and Capt. W. G. Williams, then in charge of harbor improvements on Lake Erie, with station at Buffalo, was directed by a letter of May 17, 1841, to take charge of the survey and under the appropriation made March 3, previously. A few years thereafter the office was removed to Detroit, Mich., where it remained until the field work of the survey was completed in 1882, and that place has since remained the point for the distribution of the charts of the lakes.

From 1841 the survey of the lakes was carried on under the following appropriations:

Mar. 3, 1841	$15,000
May 18, 1842	20,000
Mar. 1, 1843	30,000
June 17, 1844	20,000
Mar. 3, 1845	20,000
Aug. 8, 1846	25,000
Aug. 12, 1848	25,000
Mar. 3, 1849	10,000
Sept. 28, 1850	25,000
Mar. 3, 1851	25,000
Aug. 30, 1852	25,000
Mar. 3, 1853	50,000
Aug. 5, 1854	50,000
Mar. 3, 1855	50,000
Aug. 30, 1856	50,000
Mar. 3, 1857	50,000
June 12, 1858	75,000
Mar. 3, 1859	75,000
June 21, 1860	75,000
Mar. 2, 1861	75,000
July 5, 1862	105,000
Feb. 9, 1863	106,879
July 2, 1864	$100,000
Feb. 28, 1865	125,000
June 12, 1866	50,000
Mar. 2, 1867	155,000
July 20, 1868	75,000
Mar. 3, 1869	100,000
July 15, 1870	100,000
Mar. 3, 1871	175,000
June 10, 1872	175,000
Mar. 3, 1873	175,000
June 23, 1874	175,000
Mar. 3, 1875	150,000
July 31, 1876	84,000
Mar. 3, 1877	94,500
June 20, 1878	49,500
Mar. 3, 1879	85,000
June 16, 1880	40,000
Mar. 3, 1881	18,000
Aug. 7, 1882	12,000
Total	2,939,879

The field work of the survey being completed, the office of the survey was closed in August, 1882, and the records transferred to this office. The printing of the final report was completed in November, 1882. Work in connection with the engraving and printing of the charts still remained, but of the appropriation of $12,000 last above-mentioned $2,382.32 was returned to the surplus fund of the Treasury.

At that time the charts were perfected to the full needs of navigation under the then existing conditions.

From the completion of the field work to the present time the following appropriations have been made, which have been applied to printing, electrotyping, and issuing charts for the use of navigators:

Mar. 3, 1883	$3,000
July 7, 1884	3,000
Mar. 3, 1885	3,000
Aug. 4, 1886	2,000
Mar. 3, 1887	2,000
Oct. 2, 1888	2,000
Mar. 2, 1889	2,000
Aug. 30, 1890	$2,000
Mar. 3, 1891	2,000
Aug. 5, 1892	2,000
Mar. 3, 1893	2,000
Aug. 18, 1894	2,000
Total	27,000

To June 30, 1894, the aggregate of $8,719.85 has been turned into the Treasury from the sale of charts. Up to February 20, 1890, charts to vessels navigating the Great Lakes were, by regulation, issued free, not to exceed one set to each vessel; charts to other parties to be sold at 30 cents each. From and after that date no more free issue was made, and charts were sold at 30 cents each, this price continuing until July 16, 1890, since which date the price has been 20 cents for the regular series.

Because of the phenomenal increase of commerce on the lakes, and under the stimulus of the increased depth made practicable through the St. Marys River by the completion of the new lock and the increase of depth obtained by the improvements made in the channels of the rivers and in the harbors of the lakes, the draft of lake vessels has steadily increased, and therefore the interests of navigation have required reexamination of certain shoaler areas sufficiently surveyed and charted for the older conditions of a 12-foot navigation.

In 1887 a vessel struck on a shoal and in 14 feet of water where 22 feet was shown. This obstruction was found to have been a detached bowlder about 6 by 4 feet on top, and this occurrence suggested the desirability of having funds available for limited surveys in such cases as this and for keeping the charts in all respects up to date. Accordingly an estimate of $10,000 was submitted with the Annual Report of 1887, which estimate was repeated for the Annual Report of 1888. An appropriation of $5,000 was made March 2, 1889, for "surveys, additions to, and correcting engraved plates." This and succeeding appropriations for the same purpose to date are as follows:

Mar. 2, 1889	$5,000
Aug. 30, 1890	10,000
Mar. 3, 1891	10,000
Aug. 5, 1892	5,000
Mar. 3, 1893	$25,000
Aug. 18, 1894	25,000
Total	80,000

Under these appropriations, reexaminations have been made of various localities, as shown by the annual reports, and quite extensive reexaminations are now under way on the St. Marys and St. Lawrence rivers.

Under the supervision of this office, and during the fiscal year, additions have been made to the engraved copperplates of charts of—

Lake Superior, Nos. 1 and 3.
Ontonagon Harbor, Lake Superior.
River Ste. Marie, No. 1.
Straits of Mackinac.
North end of Lake Michigan.
South end of Lake Michigan.
North end of Green Bay.
South end of Green Bay.
Coast chart, No. 1, Lake Michigan.
Coast chart, No. 3, Lake Michigan.
Coast chart, No. 4, Lake Michigan.
Coast chart, No. 5, Lake Michigan.
Coast chart, No. 6, Lake Michigan.
Coast chart, No. 7, Lake Michigan.
Coast chart, No. 9, Lake Michigan.
Lake Huron.
Presqu' Ile and Middle Island, Lake Huron.
Saginaw Bay, Lake Huron.
Saginaw River.
South end of Lake Huron.
Detroit River.
Lake Erie.
Coast chart, No. 1, Lake Erie.
Coast chart, No. 4, Lake Erie.
Coast chart, No. 5, Lake Erie.
Coast chart, No. 7, Lake Erie.
Lake Ontario.
Coast chart, No. 3, Lake Ontario.
Coast chart, No. 4, Lake Ontario.
St. Lawrence River, No. 4.
St. Lawrence River, No. 5.

New electrotypes of the following plates have been made:

St. Lawrence River, No. 1.
Saginaw River.

A chart of the Lake Front, Chicago, Ill., on a scale of 1:24000 has been prepared and is now in the hands of the photolithographer.

During the year, 4,931 charts were distributed under the supervision of Col. O. M. Poe, Corps of Engineers, at Detroit, Mich. Of these 4,542 were sold at 20 cents each, 26 at 10 cents each, and 3 at 5 cents each. In addition, 44 charts were sold from this office at 20 cents each, and 42 from the office of Capt. W. L. Marshall, Corps of Engineers, at Chicago, Ill., at 5 cents each. The total amount received from the sale of charts was $922.05, which has been turned into the Treasury. The total appropriation for printing and distributing these charts was only $2,000. Were it not for the fact that the distribution is made from an office already organized for river and harbor work, the necessary supply of charts could not be printed and distributed for so small an appropriation.

Under the direction of Col. O. M. Poe, Corps of Engineers, extensive alterations are being made to Chart No. 1, St. Marys River, showing section 1 of the 20 and 21 foot channel and the Hay Lake improvement. For this purpose the chart is being extended so as to take in Middle Neebish. The head of Collingwood Channel is also to be added to this chart. The cities of Sault Ste. Marie, Michigan and Ontario, are to be reduced from the field sheets of the resurvey of St. Marys River, 1893. The alterations in this chart are very nearly completed. Work was also commenced on the combined chart of Lake Superior and the following progress made: Completed 845 miles of inshore and offshore hydrography; 800 miles of shore line with the adjoining topography, 3 to 5 miles back from shore. In addition to the above the topography on the eastern end of Lake Superior and on both sides of St. Marys River from Point Iroquois and Gros Cap to Little Rapids was reduced from the resurvey of St. Marys River, 1893, and inked in.

During the fiscal year surveys and examinations were in progress as follows:

Resurvey of St. Marys River, from Whitefish Bay to Detour Lighthouse.—This survey is being executed under the supervision of Col. O. M. Poe, Corps of Engineers. The following work was done during the fiscal year: Observations and computations for longitude and computations for latitude were completed. The triangulation connecting the triangulation of Lake Superior with that of the Straits of Mackinac was practically planned. Some changes may be necessary. Eighteen primary and 12 secondary stations were built and the necessary lines of sight cut. The angles at 11 stations were measured. About 90 square miles of topography were completed. The completed triangulation and the tertiary triangulation of the St. Marys River survey were adjusted and the geodetic coordinates of the stations computed.

Enough data is now on hand to permit the publication of Chart No. 3 St. Marys River, with the exception of the hydrography. The surveys incident to the improvement of the ship channel will furnish this data.

(See Appendix D D D 1.)

Reexamination of St. Lawrence River.—Work has been carried on by Capt. Smith S. Leach, Corps of Engineers, under an allotment of $4,275 from the appropriation for survey of Northern and Northwestern lakes, this allotment being based on the estimated cost of a resurvey of the main ship channel for a width of 2,000 feet from Lake Ontario to the foot of the Brockville Narrows at Morristown, a distance of 40 miles. Owing to the very uneven conformation of the bed of this part of the river, the method of isolated soundings heretofore employed in all hydrographic surveys of a general character was inherently defective and several shoals not disclosed by the original survey had been reported. It was desired to examine the part of the channel used by deep-draft vessels under such conditions as to leave no possibility of points of rock remaining undiscovered which could be touched by vessels, and it was decided to employ the method of continuous sweeping, for many years in use in verifying the removal of rock to certain specified planes, but never before adapted to use on such a large scale. The apparatus devised and the method of working it are described in a general way only in the report of Captain Leach, as the work remains unfinished and some details will be modified in the future. Preparations were begun early in July, and the party reached the point of beginning at Sister Island on the 21st. The work was closed on September 19 at the head of Brockville Narrows, 9½ miles from the point of beginning. In this distance 14 new shoals were discovered.

(See Appendix D D D 2.)

Continual effort has been made to keep the charts up to date, and a very considerable number have been corrected during the year, and the special examinations made in connection with river and harbor work have been made use of whenever available. If it were not for this collateral assistance a number of very important charts would, owing to lack of funds to make surveys, be in a very imperfect, and, in some cases, useless condition.

As soon as the funds available will permit it is proposed to prepare and publish general charts of lakes Superior and Michigan, each on one sheet, there being a great demand for these charts at present; also to prepare and publish coast charts of lakes Huron and Superior in order to complete the set of charts of the lakes.

These projects or something of a similar nature will have to be carried out if the charts are to be rendered of the greatest service to navigators. The work already done, particularly the location of the dangerous shoals in Lake Erie, has fully demonstrated the necessity which exists for work of this character. The lake marine is of too great importance to the country at large for any effort looking toward its safety to be spared. When the Government sells charts to navigators these charts should embody the latest and most accurate information concerning the localities to which they refer, and everything should be done to render navigation safe and certain.

The low water of recent years, combined with the great increase in size and number of vessels, has resulted in the larger and more expensive vessels discovering dangers previously unknown, and discovering them by the costly process of striking them. All dangers so discovered should at once be surveyed and located upon the charts, in order to prevent the repetition of similar accidents at the same point. Localities deemed perfectly safe for navigation when smaller vessels were used are now regarded with suspicion by the larger vessels, and it is essential that certain special areas should be reexamined.

St. Marys River is one of the localities on the lakes where new surveys are essential in order that the charts may be rendered of the greatest service; the surveys upon which the present charts are based were made between 1853 and 1857, and since that time the region tributary to the river has undergone an enormous development. Nearly 11,000,000 tons of freight now pass through the river annually, and extensive works of improvement have been completed and are in progress. Since the original surveys were made the draft of vessels has increased from 9½ and 12 feet to 16 feet and will shortly be increased to 20 feet. The river is a difficult one to navigate with the large vessels of the present time, and new charts are absolutely essential. The records of the former survey and of the river improvement will prevent all duplication of work, and will permit the survey to be pushed to completion as quickly as possible.

The organized districts in connection with river and harbor work now established at the chief cities on the lakes will greatly facilitate keeping all of the charts up to date, and will insure the maximum results with the minimum cost.

In view of the great importance of this work to the lake marine an appropriation of $50,000 for surveys and other expenses connected with correcting and extending the charts of the Northern and Northwestern lakes is most earnestly recommended, as the conditions now existing are urgent and require that this amount should be available at the earliest possible moment, and an appropriation of $3,000 is recommended for the printing and distribution of the charts.

Annual water levels of the Northern and Northwestern lakes.—A table showing the monthly means of water levels from July 1, 1893, to June 30, 1894, at Charlotte and Oswego, Lake Ontario; at Erie, Ashtabula, Cleveland, and Monroe, Lake Erie; at Milwaukee, Lake Michigan; at Escanaba, Green Bay (no observation being made at this latter place from December 16, 1893, to March 19, 1894); at Sand Beach, Lake Huron, and at Sault Ste. Marie and Marquette, Lake Superior, being in continuation of that published in the Annual Report of the Chief of Engineers for 1893, will be found in Appendix D D D 3.

CONSTRUCTION AND IMPROVEMENT OF ROADS AND BRIDGES IN YELLOWSTONE NATIONAL PARK.

Officer in charge, Maj. William A. Jones, Corps of Engineers; Division Engineer, Col. O. M. Poe, Corps of Engineers.

This work has been in the charge of the Engineer Department since 1883.

The project embraces a belt line road, commencing at Gardiner, on the north boundary line of the park; thence to Mammoth Hot Springs; thence to Upper Geyser Basin via Norris Geyser and Lower Geyser basins; thence to the outlet of Yellowstone Lake via Shoshone Lake and the west arm of Yellowstone Lake, crossing the Continental Divide of the Rocky Mountains twice; thence to Yanceys via the Falls and Grand Canyon of the Yellowstone River; thence to Mammoth Hot Springs, completing a circuit of about 145 miles. There are also included in the project a road from the west boundary line of the Park to intersect the road along the Yellowstone River, between the lake outlet and the falls, via Lower Geyser Basin; a road from Norris Geyser Basin to the Falls of the Yellowstone; a road from Yanceys to the east line of the park, and short branch roads to points of interest, comprising in all about 225 miles of new roads, with necessary bridges and culverts. Estimated cost, as revised in 1889, $144,779.42.

The act of Congress approved March 3, 1891, changed the project of that part of the belt line between Lower Geyser Basin and Yellowstone Lake by requiring the road to be built "by the shortest practicable route" from Fountain Geyser to the Thumb of Yellowstone Lake. This change did not materially affect the cost.

The act of Congress approved August 5, 1892, appropriated $45,000 and provided—

> That fifteen thousand dollars of this amount, or so much thereof as may be necessary, may be expended, in the discretion of the Secretary of War, for the construction of a road from the Upper Geyser Basin to a point on Snake River where it crosses the southern boundary of the park.

This act has been construed as the wish of Congress to modify the project by adding about 33½ miles of roads, which will considerably increase the estimated cost made in 1889.

One hundred and thirty-five miles of main road and 35 miles of side road remained to be built June 30, 1893. The estimated cost of this unfinished work was $410,100.

At the beginning of the year roads had been opened up which enabled tourists to visit Mammoth Hot Springs, Norris Geyser Basin, Lower Geyser Basin, Upper Geyser Basin, Yellowstone Lake, the Falls, and upper end of the Grand Canyon of the Yellowstone River. Total amount expended upon the project since commencement of work in 1883 to June 30, 1893, including outstanding liabilities, $373,779.42.

During the past year the bulk of the work has been in repair and improving the construction of existing roads. The new road from West Thumb of Yellowstone Lake toward south boundary of the Park was cleared and grubbed to a point 15½ miles distant from the lake. The new roads at Norris and Fountain Geyser basins were completed. The beach road along Yellowstone Lake was placed in a passable condition. The new road, 1 mile long, at the Upper Falls of the Yellowstone River was completed, except the wooden arch over the ravine; the latter is almost ready for travel over it. About two weeks' work will finish it. The road to Inspiration Point commenced last year was completed.

Amount expended during fiscal year ending June 30, 1894, including outstanding liabilities, $36,000.

July 1, 1893, balance unexpended	$38,810.56
June 30, 1894, amount expended during fiscal year	37,170.41
July 1, 1894, balance unexpended	1,640.15
July 1, 1894, outstanding liabilities	1,640.15
Amount appropriated by act of August 18, 1894	30,000.00
Amount available for fiscal year ending June 30, 1895	30,000.00
Amount (estimated) required for completion of existing project	*130,000.00

(See Appendix E E E.)

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*According to estimate of 1889, which was too low.

MILITARY AND OTHER MAPS.

The following maps and plans have been photolithographed and an edition printed:

Map of modification of the pierhead and bulkhead lines for the north shore of the East River from Oak Point to Hunts Point, New York City, N. Y.

General and detail drawings of the gates of the 800-foot lock. St. Marys Falls Canal, Michigan, in 14 sheets.

RECONNAISSANCES AND EXPLORATIONS.

The following officers have been on duty at the headquarters of the military departments engaged in preparing such maps and making such surveys as were required by their respective commanding officers:

Lieut. Cassius E. Gillette, Corps of Engineers, at headquarters, Department of the Missouri, to August 26, 1893, since which date Capt. William L. Marshall, Corps of Engineers.

Maj. Tully McCrea, Fifth U. S. Artillery, at headquarters, Department of the Columbia.

Lieut. Charles G. Lyman, Second U. S. Cavalry, at headquarters, Department of California.

Capt. William L. Marshall, Corps of Engineers, engineer officer, Department of the Missouri, reports that no field work has been done during the year; that the office work has consisted in the preparation of maps, tracings, reproductions, etc., mounting, correcting, and issuing maps; and that contour maps have been or will be made of the posts of Forts Leavenworth, Mackinac, Sill, Supply, and Wayne.

(See Appendix F F F 1.)

Maj. Tully McCrea, Fifth U. S. Artillery, acting engineer officer, Department of the Columbia, reports that field operations have consisted in minor surveys for the improvement of the drainage system and rifle range at Vancouver Barracks, and the survey of roads through and adjacent to the Vancouver Barracks military reservation; that surveys are being made to obtain data for the preparation of contour maps of the posts of Forts Townsend, Sherman, Walla Walla, and Spokane, and that the office work has consisted in the revision of the department map, collecting information in regard to the Indian and military reservations in the department, the preparation of maps, plans, tracings, solar prints, and plats, and mounting and issuing maps.

(See Appendix F F F 2.)

Lieut. Charles G. Lyman, Second U. S. Cavalry, in charge of engineer office, Department of California, reports that the office work has involved the preparation of original drawings, tracing and blue printing of maps, etc., mounting and distribution of maps, the care and preservation of surveying instruments in store, and issuing the same to the different posts, to troops in the field, and to the quartermaster's department. No field work of any importance, with the exception of the survey of a road on the Presidio Reservation for the depot quartermaster, has been entered into during the year.

(See Appendix F F F 3.)

ESTIMATES FOR AMOUNTS REQUIRED FOR SURVEYS AND RECONNAISSANCES IN MILITARY DEPARTMENTS, AND FOR MAPS, INCLUSIVE OF WAR MAPS.

For military surveys and reconnaissances and surveys of military reservations by the engineer officers attached to the several headquarters of military departments, being an average of $2,142.86 for each of seven military departments west of the Mississippi River, $15,000; for publication of maps for use of the War Department, inclusive of war maps, $10,000; total, $25,000.

Attention is specially invited to this estimate for appropriation and to the important uses for which it is intended.

At the headquarters of the military departments west of the Mississippi River there are stationed officers of the Corps of Engineers, or other officers detailed to act, whose duty it is to make reconnaissances for military purposes, to make such surveys and prepare such maps as may be required by their respective commanding officers. In recent years no appropriations have been made for these purposes, and, consequently, these officers have been very much cramped for lack of the necessary means, and the usefulness of their offices has been very much reduced in consequence. The maps of these departments are constantly in need of revision and additions, which the officers make so far as possible, but with no means, even for the purchase of paper, their efforts are limited in results.

Paragraph 383 of the Army Regulations requires that the commanding officer of each post where there are fixed batteries bearing upon a channel will call upon the Engineer Department for accurate charts showing the soundings to the extent of the ranges of the guns. Calls upon this department to perform its duty under this regulation can not be honored from lack of means.

Interest in the war maps published by this office and republished by virtue of the sundry civil act of March 2, 1889, continues very active. Of the 1,100 copies of each map printed under the act alluded to, all those not printed in this office (47 sheets) have been exhausted for some time, and the calls for them can only be honored with sets deficient in that number of sheets.

Besides all this, there is much information in this office relative to military geography which could with little expense be made available for the information of officers of the Army; for instance, there are on the office files detailed maps of regions of Europe which may become at an early day the theaters of war, and it would be of great advantage to the service if such information as these maps give could be made available for the study of officers, especially on the outbreak of hostilities. Were the means provided, this office would be glad to compile and to disseminate the information on its files.

It is the policy of this country to keep a standing army small in numbers, but it is its expectation that it should be a highly instructed one, and a small outlay as here referred to will be conducive to that end.

Applications from officers of the Army have been received for maps of certain regions of Europe, and it was with great regret that this office could not render this assistance to officers desirous of improving themselves professionally, especially when the material was on its files.

OFFICE OF THE CHIEF OF ENGINEERS.

During the fiscal year ending June 30, 1894, the following-named officers were on duty in this office as my assistants:

Maj. Henry M. Adams, Maj. Thomas Turtle, and Capt. John G. D. Knight.

Very respectfully, your obedient servant,

THOS. LINCOLN CASEY,
Brig. Gen., Chief of Engineers.

Hon. DANIEL S. LAMONT,
Secretary of War.

APPENDIXES

TO THE

REPORT OF THE CHIEF OF ENGINEERS,

UNITED STATES ARMY.

APPENDIXES

TO THE

REPORT OF THE CHIEF OF ENGINEERS,

UNITED STATES ARMY.

FORTIFICATIONS, ETC.

APPENDIX No. 1.

TORPEDO SHED, NEW YORK HARBOR.

REPORT OF LIEUT. COL. HENRY M. ROBERT, CORPS OF ENGINEERS, OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1894.

ENGINEER OFFICE, U. S. ARMY,
New York, N. Y., July 9, 1894.

GENERAL: I have the honor to transmit herewith annual reports upon fortifications and other works of defense in my charge for the fiscal year ending June 30, 1894. * * *

Very respectfully, your obedient servant,

HENRY M. ROBERT,
Lieut. Col., Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

[Extract.]

The fireproof storage building for torpedo material was in progress at the beginning of the fiscal year, the concrete foundation and about one-half the lower story having been at that time built.

During the year the walls have been completed, the iron roof put on, doors and windows and their shutters placed, and the board flooring laid where needed. To put the building in condition for service there is now required a concrete flooring, the machinery for handling the mines, and a small amount of work to finish incomplete details, all estimated to cost $3,323.51.

COST OF TORPEDO BUILDING.

Foundations.

Excavation, 382 cubic yards earth, at $0.912147	$348.44
Concrete masonry, 253 cubic yards, at $8.02276	2,029.76
Total	2,378.20

Masonry wall.

Stonework, granite with brownstone backing, 472 cubic yards, at $25.612	12,088.98
Brickwork, 296.5 cubic yards, at $12.985	3,850.04
Total	15,939.02

Earth embankment.

Inside filling of earth, 915 cubic yards, at $0.3692	337.88
Grading long slope behind the building	361.35
Terrace beside the building	344.10
Gutters, 1,657 square feet cobblestone paving, at $0.14337	237.57
Total	1,280.90

Carpenter work.

Windows and doors	607.71
Floors	530.59
Total	1,138.30

Iron work of roof, windows, etc.

Contract with Manhattan Supply Company:	
Iron roof in place	2,970.00
4 double iron shutters	64.80
55 double iron window shutters, at $7.89	433.95
2 rolling iron doors, at $37.40	74.80
	3,570.55
Hardware, etc	115.85
Total	3,686.40

Superintendence, office, etc.

Superintendence	1,053.26
Legal holidays	204.50
Advertising	79.75
Printing	12.50
Total	1,350.01
Miscellaneous	5.03
Expendible material on hand	52.70
Grand total	25,830.56

APPENDIX No. 2.

GUN AND MORTAR BATTERIES—TORPEDO SHED, NEW YORK HARBOR.

REPORT OF LIEUT. COL. GEORGE L. GILLESPIE, CORPS OF ENGINEERS, OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1894.

IMPROVEMENTS.

a. Mortar battery.	*c.* Torpedo shed.
b. Gun-lift battery.	*d.* Emplacement for 10-inch gun.

ENGINEER OFFICE, U. S. ARMY,
New York, N. Y., July 2, 1894.

GENERAL: I have the honor to transmit herewith annual reports, in duplicate, for the fiscal year ending June 30, 1894, upon fortifications in my charge.

Very respectfully, your obedient servant,

G. L. GILLESPIE,
Lieut. Col., Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

2 A.

[Extract.]

MORTAR BATTERY NO. 1.

Under sealed proposals opened April 12, 1893, the following material for the construction of mortar platforms has been purchased:

1. From Waldo & Stout, Bridgeport, Conn.:
   - 384 aluminium bronze bolts, at 29½ cents per pound.
   - 384 phosphor bronze washers, at 22½ cents per pound.
   - 384 steel nuts (for above bolts), at 57½ cents each.
   - 256 wrought iron anchor bolts, with hexagonal nuts, at 39 cents each.

The aggregate cost of the above nuts and bolts for sixteen platforms is $7,085.75.

2. From Casey & Sherwood, Groton, Conn.:

For sixteen sets of eight stones each, or 2,126 cubic feet granite rings (which form the upper surface of the mortar platforms and the seat of the base ring of the mortar carriage), at $319 for one set, equivalent to $2.4007 per cubic foot.

Under sealed proposals opened November 6, 1893, a bid for furnishing steel jam nuts for the holding-down bolts was accepted from William Gaskell & Sons, Brooklyn, N. Y., for

192 hexagonal steel jam nuts, 2¾ inches by three-fourths of an inch deep, 1¾ inches opening, at 22 cents each.
192 hexagonal steel jam nuts, 2½ inches by 1 inch deep, 1¾ inches opening, at 22 cents each.

All deliveries under the above agreements have been completed.

During the year the masonry of the battery, including the counterscarp wall, has been completed, except the floor of the southern transverse gallery (about 23.5 cubic yards).

An ammunition-service track, 3 feet gauge, of girder rails, 70 pounds per yard, has been laid in the galleries and along the rear of the mortar pits as far as the floor construction has been carried. Turntables are set at the intersections of the galleries and at the entrances to the pits in the west ditch. At the latter points this track connects with a track through the main entrance of the battery, extending to the Engineer Wharf.

Bullet-proof doors have been provided and hung at the main entrance and at each of the counterscarp galleries. The sand filling of the main parapet has been completed; the embankment outside the counterscarp wall has been completed, except along the south side, where the battery is not exposed, and which it was thought best to leave until the more essential work was done.

The total amount of masonry in place is 29,676 cubic yards, which, with 255 cubic yards still to be placed in the platform foundation and the floors of the south pits, and in the floor of the south transverse gallery, makes the total quantity in a complete battery of this type 29,931 cubic yards.

The total amount of sand excavated and placed in the main parapet and counterscarp embankment is 157,539 cubic yards. Of this amount 7,194 cubic yards were rearrangement of sand previously placed, caused by the action of the wind. The total quantity in the completed battery is therefore 150,345 cubic yards.

MORTAR PLATFORMS.

When the work of construction of this battery began in November, 1890, no carriage for the mortar had been adopted by the Government, and therefore no studies had been made for the requisite platforms.

A suitable carriage, called the spring-return carriage, having been adopted early in 1892, plans for the platforms were proposed by The Board of Engineers, and approved by the Chief of Engineers March 10, 1893, which contemplated the formation of circular wells of concrete, 4 feet 11 inches interior radius and 12 inches deep, faced with granite blocks, which had an extreme rise of 15 inches. The thickness of the concrete forming the bottom of the well was 3 feet 10½ inches at the center, and 4 feet on the periphery.

As the water penetrated the surrounding sand under ordinary conditions to the height of 4 feet, approximately, above mean low water, and the lower surface of concrete was projected to be laid at 2 feet 3½ inches above mean low water, the practicability of excavating the inclosed sand economically without injury to the breast-height walls of the pits, located at 5 feet above mean low water, which had already been built, became a problem of serious import.

The work of excavating for these foundations began early in July, 1893. The sum of $20,000 had been allotted for the construction of eight platforms, but, owing to the success of the method employed for sinking the foundations, this sum proved to be greatly in excess of that required for eight platforms, and work was carried on on the entire sixteen.

The method adopted was proposed by Mr. J. H. Casey, assistant engineer. It consisted in draining the sand in the vicinity of the excavation by pumping from well-points distributed over the area and connected with a single pump.

The fresh-water supply for the construction plant on the work is from such a system, and experiments in this direction showed the practicability of lowering the level of the water in their vicinity by continuous pumping, and also furnished data as to the size of plant required for the work proposed.

Work was confined to a single pit at a time, the entire plant being removed and transferred as required. For the two northern pits 12 well-points were used, located as shown in the drawing, fig. 1. The wells were 1½ inches in diameter and driven to about 2 feet below mean low water. They were connected together at the upper end and to the pump by a line of pipe 5 inches in diameter at the pump and diminishing to 1½ inches at the extremities. The pump used was a Blake tank pump, with a 12-inch stroke, an 8-inch water cylinder, and a 5-inch suction, which, at a speed of 100 strokes per minute, gave a capacity of about 260 gallons per minute. It discharged through the main drain from the pit into the general drainage system of the battery. The pump was one that was on hand here, having been purchased for general use. Steam was supplied from the 20-horse-power boiler of a double-drum hoisting engine on the work.

Water gauges, to determine the effect of the pumping and the area drained, were located as indicated on fig. 2 of the accompanying drawing, one in the northeast pit, two in the northwest pit, one in the ditch near the entrance to the north pits, and a fifth (not shown on the drawing) in a sand pit about 200 feet south of the battery, where it would be well beyond the effect of the pump. These gauges consisted of well-points driven in the usual way and provided with interior cylindrical floats of tin. The elevation of the water was indicated by the upper extremity of an upright rod fastened to the float and moving over a vertical scale, the zero of the scale corresponding to mean low water. During the pumping for the two north pits, readings were taken on the gauges every hour and the result recorded. The record made during the pumping for the northwest pit is given below, to show the local effect of the pumping. The pump was started at 10 p. m. August 9, and ran with but slight intermission until 2:40 p. m. August 11, when the concrete foundation was high enough to be out of danger from submergence.

At 8 a. m. August 10, the water was found to be low enough to admit of excavation, and the work was accordingly begun and carried on as rapidly as the lowering of the water would admit. Concrete was placed as fast as the excavation was ready, the pump being worked continuously until 2:40 p. m. August 11, when the concrete was up to elevation 4.2.

Date.	Time of day.	Gauge readings.				Remarks.
		I.	II.	IV.	V.	
		Feet.	*Feet.*	*Feet.*	*Feet.*	
Aug. 9	10 p. m	4.02	4.03	4.01	....	Gauge III was not read.
	11 p. m	4.11	5.05	4.02	....	
	12 p. m	3.09	2.10	4.02	....	
Aug. 10	1 a. m	3.29	2.74	4.02	....	
	2 a. m	3.33	2.05	4.02	....	
	3 a. m	3.07	2.03	4.02	....	Stopped pump 3.30.
	4 a. m	3.75	2.25	4.01	....	Started pump 4.10.
	5 a. m	3.30	2.02	4.02	....	Stopped 5.10
	6 a. m	3.22	3.25	4.06	....	Started 6.25
	7 a. m	3.70	2.20	4.20	....	
	8 a. m	3.65	1.92	4.20	....	Excavating for platforms began.
	9 a. m	3.60	1.92	4.20	4.05	
	10 a. m	3.67	1.87	4.20	4.05	
	11 a. m	3.56	1.86	4.10	4.07	
	12 m	3.54	1.84	4.09	4.07	
	1 p. m	3.53	1.80	4.06	4.03	
	2 p. m	3.52	1.82	4.06	4.03	
	3 p. m	3.51	1.70	4.05	4.04	
	4 p. m	3.50	1.82	4.05	4.04	
	5 p. m	3.05	1.08	4.05	4.03	
	6 p. m	3.04	1.07	4.05	4.03	
	7 p. m	3.04	1.07	4.00	4.06	
	8 p. m	3.04	1.07	4.00	....	
	9 p. m	3.04	1.07	4.00	4.06	
	10 p. m	3.04	1.06	4.00	....	Stopped at 10.
	11 p. m	3.04	2.02	4.00	....	Started at 11.
	12 p. m	3.04	1.09	4.00	....	
Aug. 11	1 a. m	3.04	1.08	4.00	4.06	
	2 a. m	3.04	1.08	4.00	....	
	3 a. m	3.04	1.09	4.00	4.06	
	4 a. m	3.04	1.09	4.00	....	
	5 a. m	3.38	2.00	4.00	....	
	6 a. m	3.38	2.05	3.98	3.98	
	7 a. m	3.38	2.00	4.00	....	
	8 a. m	3.42	1.90	3.98	....	
	9 a. m	3.42	1.95	3.98	3.98	
	10 a. m	3.42	1.86	3.98	....	
	11 a. m	3.42	1.90	3.98	....	
	12 m	3.42	1.90	3.98	3.98	
	1 p. m	3.44	1.90	3.98	....	
	2 p. m	3.44	1.95	3.98	4.05	Pump stopped at 2.40 p. m.
	3 p. m	3.44	2.10	3.96	....	
	3:30 p. m	4.40	4.40	4.40	....	
	5 p. m	3.55	3.30	3.96	4.05	

The draining of the pit in this way left the sand free from water, but damp enough to stand vertical under the wall of the pit, enabling the concrete to be put in against it without forms. Wooden forms were used for the concrete of the platforms except where it came under the footing of the wall. No special care was taken to preserve the well-points that came within the concrete, but they were afterwards withdrawn, only two being lost in the operation.

The plan worked well from the first, and no unforeseen difficulties were met with. At the time of the excavating for the south pits, on October 9, the general level of the water in the soil was higher, being about 4.8 feet; in addition to this fact, a bed of coarse gravel about 3 feet thick underlying the foundations allowed the water to flow in the soil more readily, and the one pump was found to be insufficient. In the southeast pit twelve hours continuous pumping lowered the water only 1.2 feet. It was therefore thought best to increase the plant by a second smaller pump, connected to six well-points distributed over the center of the area to be drained, before beginning work. Even with this additional power headway was made but slowly against the water, and so the pumps were run continuously from 3 p. m. October 9, to 1 p. m. October 11, before it was deemed safe to stop the small pump; the large pump was continued until noon of October 12. It should be stated that the insufficiency of the increased plant was probably partly due to the inability of the boiler to supply sufficient steam for both pumps.

The bolts, 24 in number, that hold the roller path to the platform, extend entirely through the concrete foundation, where they are held at the bottom by washers. As the setting of these bolts is an operation requiring great accuracy, it was thought best not to attempt it while the foundations were being put in; and their subsequent setting and adjustment was provided for in the following manner: At the bottom of the excavation, and about where the head of each bolt would come, was placed a small layer of concrete about 2 feet in diameter and 6 inches thick (fig. 4). This was rammed in place, and an empty cement barrel inverted over it. The foundation was carried up around these barrels, thus leaving holes 18 inches in diameter that allowed a large latitude in setting the bolts. The upper head being left in the barrel kept the hole clear during the progress of the work and until the time came for setting the bolts. The concrete at the bottom of the hole kept the sand from flowing in when pumping was stopped, and also served as a support for the head of the bolt during the operation of setting.

Fig. 3 shows the method used for setting the bolts. A skeleton frame, or template, swinging on a fixed center, served to hold the bolts in position after the center had been accurately located and one bolt set at the proper distance from it. The pieces of the template were not fastened together, but were simply swung over the bolts to hold them in place, the bolts being plumbed and supported at the proper level from below. The barrels were broken up and entirely removed preparatory to setting the bolts. The holes being full of water, the concrete in which the bolts were to be set was lowered to its place in bags, where it was deposited and tamped in place. The sections of the template were moved progressively around the circle as the bolts were set. The bolt at the center was set in a temporary mound of concrete, which was afterwards broken up and removed.

The platforms are all completed with the exception of the floor foundations and pavement, and setting the index rings in the southern pits. An additional allotment of $5,000 was asked for to complete the foundations; $2,000 of this sum was allotted on December 19, 1893, and the balance will be sufficient to complete the battery.

The base ring and the racer of the carriage, carrying respectively the upper and lower roller paths, are of such dimensions (13 feet 10½ inches and 14 feet in diameter, respectively) that it was necessary to deliver them into place over the main parapet of the battery. For this purpose the construction track for the battery was carried along an inclined trestle over the counterscarp wall, across the ditch, and on to the main parapet. The carriages, mounted on suitable flat cars, were brought to this incline, hauled to the top by a cable from a 20-horse-power hoisting engine on the parapet, and lowered by means of a similar incline into the pits. The smaller parts of the carriages, the cheeks, transoms, etc., as well as the mortars, were taken through the main entrance directly into the pits and handled by a derrick placed over the pits. The mortars were mounted on the carriages by means of a pair of shears made of two pieces of timber 12 inches by 12 inches by 44 feet in length. On April 13, 1894, an accident, caused by the breaking of a 4-inch rope which was being used, under a strain of 1½ tons, to lower the carriages into the southwest pit, resulted in the breaking of the base ring of carriage No. 5, and considerable damage to the platforms. The carriage ran down the incline, striking the granite rings of the two rear platforms, dislodging a number of the stones and bending several of the bronze holding-down bolts. One stone was broken so as to be useless, and was replaced by one cut from a granite block on the site of the old fort. Three of the bronze bolts had to be taken out and sent to the foundry for reforging. The cost of repairing the damage to the platforms was $187.53. The base ring of the carriage was broken so as to be useless, and, as the parts of these carriages are not interchangeable, No. 26 carriage was issued by the Ordnance Department to replace the broken one, in order to avoid the delay of waiting for a new base ring.

The carriages are now all assembled in place. The two north pits are completed and all eight of the mortars mounted therein ready for service. In the southeast pit the carriages are all assembled and the mortars mounted; and while the floor of the pit is not laid, nor the index rings set, these four mortars could also be used in an emergency. In the southwest pit the four carriages are in place and the heavier parts assembled. The mortars are all delivered at the pit, and one is mounted.

On the 22d June a proof firing took place at this battery, having for its object proof of gun, carriage, and platform, and of the effect of blast upon breast-height wall and blast slope.

The mortar used was mounted upon the southeast platform of the northeast pit.

The following table gives the characteristics of the rounds:

Number of shot.	Weight of powder, brown prismatic.	Weight of projectile, cast-iron shell.	Travel of shot in bore.	Pressure per square inch.	Time of flight.	Recoil.			
						Right side.		Left side.	
						Direct.	Counter.	Direct.	Counter.
	Pounds.	*Pounds.*	*Ft. In.*	*Pounds.*	*Seconds.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*
1	67⅜	623	3 1.2	21,859.5	....	15¾	15	16⅛	15
2	73	624	3 1.2	22,806.5	45.4	16	16	16	16
3	81¼	626	3 1.3	29,141.0	47.8	16⅛	16⅛	16⅛	16
4	78½	627	3 1.3	28,803.5	....	16$\frac{7}{16}$	16$\frac{7}{16}$	16	16
5	78	628	3 1.3	27,126.0	....	16¼	16¼	16	16

The shell used was not the service shell. The elevation of the mortar was 45° and the direction of the line of fire was S. 60° E.

The platforms, breast-height wall, and blast slope were not injured by the firings.

The following table shows in detail the cost of the various operations of construction of the battery and platforms:

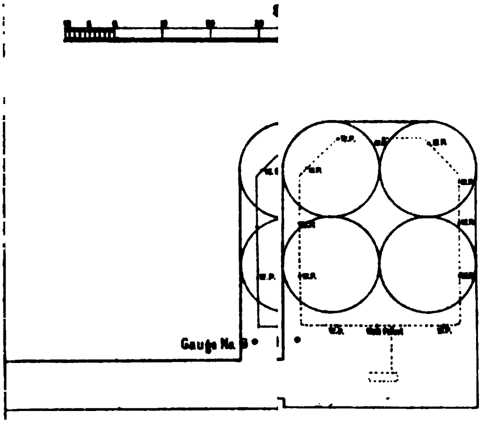
1. COST OF MASONRY CONSTRUCTION AND SAND FILLING.

A. Masonry construction.

Mixing and placing 1,475.1 cubic yards concrete, at $2.3742	$3,502.22
Cost of labor of stone mason and plasterers cutting and setting coping of main entrance and curbing for turntables, and plastering walls	215.97
Paving floors of magazines and galleries (except south entrance, 8-foot transverse gallery, and 240 square feet of 10-foot gallery, south end), labor only, 798.5 square yards, at $0.61625	492.08
Laying ammunition service track and setting turntables	247.03
Repairs to plant and moving tracks	1,370.83
Building and hanging main entrance and gallery doors	410.42
Laying permanent track through main entrance to connect with track to wharf	425.64
Total cost	6,664.19

Northeast and S

location of Wa
Pipes and Wellpoin
Plat



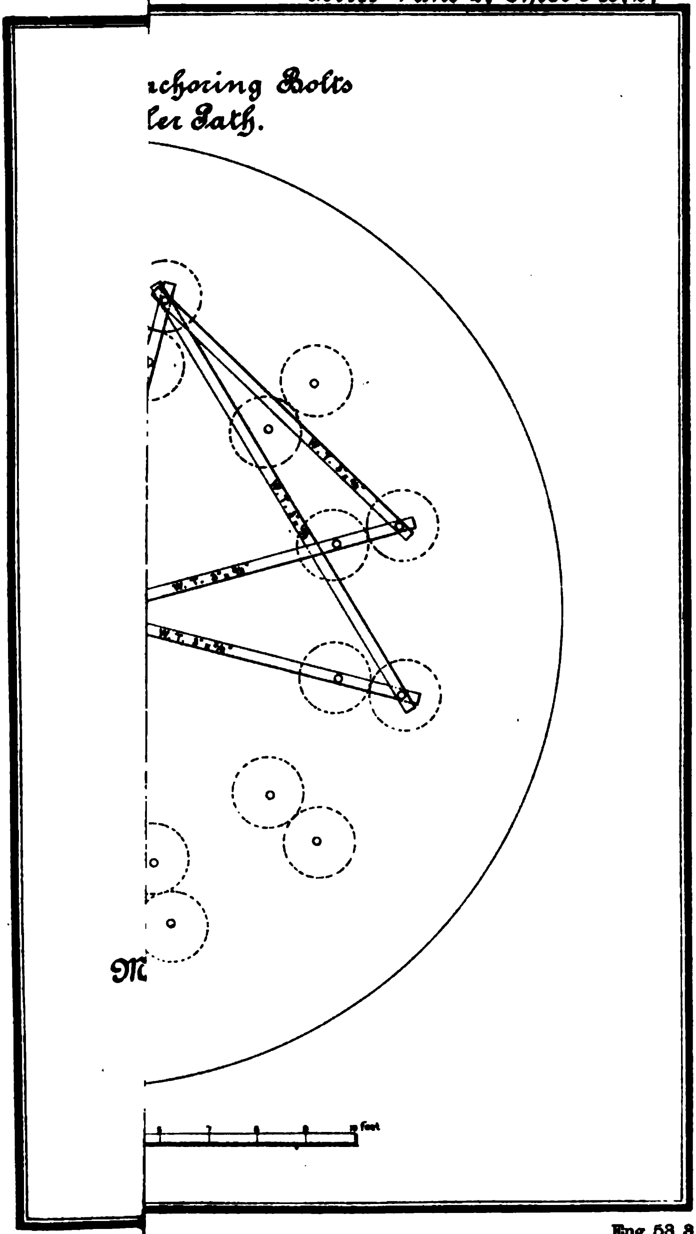
Mortar B

Sketch
mping Apparatus,
Platfor

Engineer Office, U.S.A.
New York, N.Y., June 30, 1894.
To accompany Annual Report to the
Chief of Engineers, U.S.A.

Lieut. Col., Corps of Engrs. U.S.A.

Series 1 and 2; Sheet No. 2.



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ler Path.

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Series 1 and 2; Sheet No. 2.

nchoring Bolts
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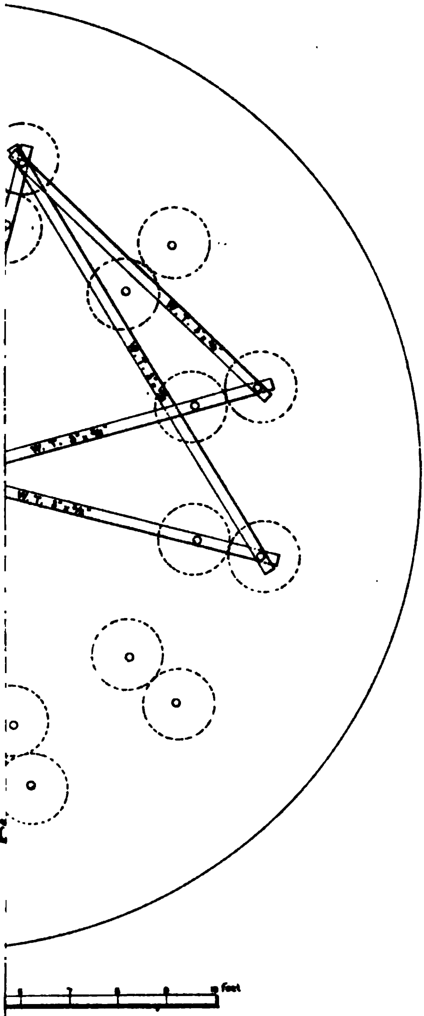

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B. Sand filling.

Cost of labor filling 27,612 cubic yards sand in embankment over magazines, around mortar pits, and on three sides of counterscarp wall, at $0.16916	$4,670.98
Cost of labor grading, sodding, protecting slopes, and planting grass seed thereon	3,429.49
Cost of labor rigging derricks, moving and setting up derricks and machinery	3,051.34
Maintenance of public animals	528.33
Repairs to quarters	786.91
Superintendence and office expenses	1,526.66
Total cost	13,993.71
Cost of masonry construction	6,664.19
Cost of sand filling	13,993.71
Cost of masonry and sand filling	20,657.90

2. CONSTRUCTION OF MORTAR PLATFORMS AND MOUNTING CARRIAGES.

Excavation:		
a. Pipes and well-points	$75.94	
b. Labor fitting and setting up pipes and well points, pumping water, and excavating for foundations	1,694.32	
		$1,770.26
For material and labor of mixing and placing 984.25 cubic yards concrete of platform foundations, at $5.578		5,490.27
Cost of labor mixing and placing foundations for, and laying of, 3-inch pavement in mortar pits, 523.86 square yards, at $0.5347		280.12
Cost of bolts, nuts, and washers for base and index rings	$7,085.75	
Cost of 16 sets of granite stones, at $319	5,104.00	
Jam nuts for base rings	85.14	
Cost of labor setting stones, bolts, base and index rings	2,359.90	
For mileage and telegrams	25.83	
		14,660.62
Cost of labor handling and setting 4 lower roller paths in northwest pit		902.43
Cost of material used in setting 4 lower roller paths (oxide of manganese, iron filings, and white lead)		32.75
Total cost		23,136.45

3. ASSEMBLING CARRIAGES AND MOUNTING MORTARS.

Cost of labor moving 16 carriages and mortars to battery, lowering into pits, cleaning and assembling carriages, and mounting 13 mortars	$3,163.87
Cost of material used in setting lower roller paths, cleaning and assembling carriages (oxide of manganese, iron filings, white lead, oil, waste, emery cloth, and files)	40.86
Cost of replacing broken stone, resetting stones, taking out, straightening and resetting bolts (broken accidentally on April 13)	187.53
Total cost	3,392.26
1. Cost of masonry construction and sand filling	20,657.90
2. Cost of construction of mortar platforms and mounting carriages	23,136.45
3. Cost of assembling carriages and mounting mortars	3,392.26
Total cost	47,186.61

The following tabular statements show the average daily number of employés of each class during the year, and the plant in use for the same period:

EMPLOYÉS.

Overseers	0.67	Monthly laborers	0.57
Clerk	.166	Teamsters	2.83
Draftsman	.166	Blacksmith	.47
Engineers	2.65	Carpenters	1.27
Firemen	2.61	Plasterer	.016
Master laborers	2.46	Stonemasons	.53
Rigger	.71	Laborers	35.05

PLANT.

Locomotive	0.46	Derricks	3.16
Hoisting engine	3.08	Dump cars	3.91
Stationary engine	.43	Flat cars	7.00
Concrete mixer	.43	Bucket grapple	.67
Horses	2.91		

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2 B.

GUN-LIFT BATTERY NO. 1.

Gun-Lift Battery No. 1 is arranged for two 12-inch, high-power, breech-loading rifled guns.

During the year the arrangements for handling ammunition were completed. They include single-rail overhead hoists at the entrance of each magazine gallery, for transferring shot, etc., to the magazine cars; and a traveling crane of 2,000 pounds capacity in each shot magazine.

The bullet-proof entrance doors were completed and hung; thus making, with the caponiére over the entrance arranged for flank defense, an adequate defensible entrance.

Sixteen shots have been fired from the north lift during the year, and nine from the south.

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2 C.

CONSTRUCTION OF TORPEDO SHED.

The general character of the building is as follows:

The building is of brick, 90 feet by 40 feet inside, with walls 1 foot thick and 12 feet high under the eaves; they are carried 1 foot below the surface, where they rest on a foundation of concrete. The floor is of concrete 1 foot thick. The roof is slate supported by eight iron trusses. A double track, 3-foot gauge, runs through the building from end to end, and is connected with the construction track on the wharf. On either side of these tracks are racks of 4 inches by 8 inches timber, arranged for the storage of buoyant torpedo cases in two tiers. A storeroom, 12 feet by 12 feet, fitted with closets and shelves for the storage of the smaller parts of the torpedo system, is located in the southeast corner of th building, and an overhead trolley, with a capacity of 3,000 pounds, provides for the handling of the anchors and ground mines, at the eastern end.

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2 D.

EMPLACEMENT FOR 10-INCH GUN.

Under contract a wharf and concrete plant were constructed at an aggregate cost of $8,402.83. This work was practically completed at the beginning of the fiscal year, the contract being closed July 14, 1893.

During May and June, 1893, a system of pipes for water supply was laid from the New Utrecht Water Company's main to the concrete plant and hoisting engines on the site.

The following plant, 1 hoisting engine and boiler, 1 vertical engine and boiler, stationary, 1 concrete mixer, 4 iron coal tubs, 7 rotary dump cars, valued at $2,545.50, was, under authority from the Chief of Engineers, transferred by sale to these works.

The above plant was designed and erected under the immediate supervision of Capt. James G. Warren, Corps of Engineers. It is of a permanent nature and has been located with a view to the construction of the entire system of defense proposed at this place. It has shown itself to be admirably adapted to the purpose and has materially reduced the cost of manufacture of concrete.

During the year 8,375.50 cubic yards of stone and 14,643 barrels of cement have been delivered.

The following amounts of material have been purchased upon sealed proposals, invited according to law:

957.3 tons large broken stone, at 50 cents per ton.
322.8 tons large broken stone, at 49.4 cents per ton.
438.3 tons large broken stone, at 58½ cents per ton.
4,480.76 cubic yards sand, at 44½ cents per cubic yard.

The mixing and placing of concrete began August 23, 1893, and continued without intermission until December 9, 1893, when masonry work was stopped for the season. Up to the latter date 6,808 cubic yards of masonry had been placed, composed of 6,180 cubic yards concrete, 611 cubic yards large stone embedded in the concrete, and 17 cubic yards cut granite.

The total quantity of excavation to July 1, 1894, is 10,867 cubic yards, being the entire amount required for the battery. This has all been used in the magazine covering and parapet of the battery. It is hard, compact clay, with occasional bowlders.

The total quantity of masonry in place is 10,362.4 cubic yards, of which 9,489 cubic yards are concrete, 838 cubic yards are derrick stone embedded in the concrete, and 35.4 cubic yards are cut stone for door casings, etc.

The following tables show in detail the cost of the various operations:

1. INSTALLATION OF PLANT.

Excavating for stone and sand bins and grading for construction tracks..	$755.64
Contract with Charles F. Mairs for constructing wharf, sand and stone bins, and cement shed	8,402.83
Services of inspector on above	287.50
Material and labor for putting slides in stone bins and erecting gates at road crossing	80.04
Material and labor for erecting carrier rollers and guide-sheaves on trestle and leads for cable	161.87
Material and labor for building flat cars, derricks, and mixer frame	500.01
Engines, dump cars, mixer, etc., transferred by sale	2,545.50
Repairs and alterations to above	455.34
Material and labor for permanent water-supply	825.58
Three engines, one friction clutch, and gearing for mixer, per requisition.	3,043.93
Setting up engines and mixer and erecting engine houses	479.64
Wire cables, ropes, etc., for fitting up derricks	1,005.37
Superintendence and office expenses during erection of plant	480.00
Total	19,023.25

2. COST OF EXCAVATION.

10,867 cubic yards material excavated, hoisted, and placed in embankment, at $0.573055 per cubic yard, including services of master laborers, engineers, firemen, blacksmith, carpenters, rigger, and laborers, and cost of coal, water, oil, waste, etc., chargeable to the account of excavation	$6,227.39
Moving and setting up derricks and general rigging work	355.38
Building and moving tracks	68.13
Moving engine	6.03
Purchase of material for operating purposes and repair and maintenance of plant	739.21
Repairs to buildings	39.29
260 cubic yards earth filling from material excavated in 1892, at $0.292855 per cubic yard	76.14
Time allowed employés for legal holidays	173.17
Superintendence and office expenses, including services of assistant engineer, draftsman, recorder, and night watchman	2,030.32
Total	9,715.06
Total cubic yards excavated	10,867
Total cost per 1 cubic yard	$0.893996

This material is hard, compact clay, with occasional bowlders.

3. COST OF MATERIAL.

	Cement, (per barrel).	Small stone (per cubic yard).	Large stone (per ton).*	Sand (per cubic yard).
On scows or canal boats alongside of wharf	$0.874	$1.134	$0.520557	$0.445
Unloading into cars	.021074	.122502	.149233	.104515
Hauling to yard or shed	.007583	.024	.049391	.026727
Storing in yard or shed	.013846	.02726	.113918	.027073
Placing large stone in wall			.267105	
Total cost of material delivered at works	.916504	1.307762	1.100204	.603315

* Average of three contracts.

4. COST OF MATERIAL AND MANUFACTURE OF 1 CUBIC YARD OF CONCRETE.

NOTE.—One charge of the mixer is equal to 1.05 cubic yards masonry in place.

A. Material:		
Broken stone, 0.92 cubic yards	$1.203141	
Cement, 1.43 barrels	1.310601	
Sand, 0.37 cubic yards	.223227	
		$2.736969
B. Manufacture and deposit:		
Charging and running mixer	.228232	
Delivering under derricks	.048868	
Hoisting	.054844	
Placing and tamping	.235431	
Making and setting up forms	.140448	
Lumber and nails	.060578	
Coal, water, oil, and waste	.049500	
		0.817941
Total		3.554910

5. COST OF MASONRY CONSTRUCTED.

9,489 cubic yards concrete masonry, at $3.55491 per cubic yard	$33,732.54
838 cubic yards large broken stone, bedded in the concrete, at $2.256035 per cubic yard	1,890.56
35.4 cubic yards cut-granite facing for doorways of magazines, cutting and setting, at $61.3265 per cubic yard	2,170.96
Steel beams in ceilings of rooms and passages of magazines, including labor	434.30
Moving and setting up derricks and general rigging work	488.54
Building and moving tracks	146.92

Repairs to buildings	$96.80
Finishing concrete walls and slopes	85.94
Moving engine	6.02
Purchase of material for operating purposes, and repairs and maintenance of plant	811.81
Time allowed employés for legal holidays	250.57
Superintendence and office expenses, including services of assistant engineer, draftsman, recorder, and night watchman	3,055.18
Total	43,170.14
Total masonry constructed, cubic yards	10,362.40
Total cost per 1 cubic yard	4.16604

TOTAL EXPENDITURES FROM OCTOBER 24, 1892, TO JUNE 30, 1894.

Installation of plant	$19,023.25
10,867 cubic yards excavation for foundations, at $0.893996 per cubic yard	9,715.06
10,362.4 cubic yards masonry constructed, at $4.16604 per cubic yard	43,170.14
Material and labor, waterproofing top of first magazine	108.35
Removing granite masonry of platforms and breast-height walls of old battery	350.74
4.4 cubic yards cut granite for facing doorways of second magazine, at $53.6323 per cubic yard (cut, but not set)	235.98
Grading and turfing earth slopes of first magazine (recently begun)	252.01
Total	72,855.53
Balance (supplies on hand)	2,752.93
Total amount expended to June 30, 1894, including outstanding liabilities	75,608.46

The following tables show the average daily number of employés of each class for the nine months during which the work was in operation and the average plant in daily use for the same time:

EMPLOYÉS.

Assistant engineer	1.0	Monthly laborer	0.5
Draftsman	.4	Carpenters	3.1
Recorder	1	Blacksmith	1
Master laborer	2.1	Rigger	1
Engineers	2.3	Stone masons	2.4
Firemen	2.2	Team	.07
Night-watchman	1	Laborers (daily)	36.3

PLANT.

Cable engines	0.8	Derricks	2.4
Stationary engine	.8	Dump cars	4.8
Hoisting engines	1.8	Flat cars	5
Concrete mixers	.8	Concrete cars	1.8

The plant available is as follows:

Cable engine	1	Derricks	5
Stationary engine	1	Dump cars	7
Hoisting engines	2	Flat cars	6
Concrete mixer	1	Concrete cars	3

Plans for drainage have been prepared, which will dispose of the rainfall in a most favorable way. An intercepting subterranean trench, built along the north side of the battery, receives the drainage from the battery and carries it to the large post sewer on the east side, which opens upon the beach with a good fall.

APPENDIX No. 3.

REPORT OF BOARD CONSTITUTED TO CONSIDER AND REPORT UPON PRICE TO BE FIXED FOR THE LAND IN THE VICINITY OF FORT MIFFLIN ON THE DELAWARE RIVER, AUTHORIZED TO BE SOLD BY THE ACT OF JANUARY 6, 1893.

UNITED STATES ENGINEER OFFICE,
Philadelphia, Pa., October 4, 1893.

GENERAL: In compliance with instructions contained in your letter to Maj. C. W. Raymond, Corps of Engineers, dated February 24, 1893, the board constituted to consider and report upon the price to be fixed for the land in the vicinity of Fort Mifflin, on the river Delaware, the sale of which is authorized by the act of January 6, 1893, and the conditions of the sale and conveyance deemed proper to protect the public interest, has the honor to submit the following report:

The board consists of Maj. C. W. Raymond, Corps of Engineers; Civil Engineer C. C. Wolcott, U. S. Navy, and Col. Cecil Clay, chief clerk of the Department of Justice, the three persons designated by the Secretary of War, the Secretary of the Navy, and the Attorney-General to represent their Departments respectively.

The board convened at the U. S. Engineer office, Philadelphia, Pa., on May 16, 1893; Major Raymond, as chairman, submitted the letter of instructions from the Chief of Engineers, dated February 24, 1893, and the accompanying papers, and laid before the board plans of the land referred to, showing the lines of the several surveys and also the boundaries of the part authorized to be conveyed. The board held other meetings for the consideration of this subject, at the U. S. Engineer office in Philadelphia, on May 17, June 17 and 19, 1893; and, on June 19, 1893, gave hearings to representatives of the International Navigation Company.

The land referred to in the act is situated at the mouth of the Schuylkill River on the right or west bank. Its location and limits are shown on the accompanying plan.* The area of the part which it is proposed to convey is $89\frac{85}{100}$ acres, more or less. The land is a mud flat deposited in recent times by the waters of the river, the upper surface averaging about 2 feet above mean low water.

The plans now in process of execution by the United States contemplate the construction of about 4,710 linear feet of earthen and pile dikes, of which 3,597 feet have already been completed. The locations of these works are shown on the accompanying plan.* It is necessary that the Government should retain the right to control and maintain these dikes, to erect others, and to remove any or all these works should it be found desirable in the future. While the removal of any of the dikes is highly improbable, the possibility of such removal must be recognized, in view of the uncertainty attending all improvements of this character. Since the land is in the immediate vicinity of Fort Mifflin and the League Island navy-yard, it is further desirable that its occupation in any offensive or dangerous manner should be prohibited.

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*Omitted.

The board therefore recommends that the deed conveying the land shall contain a clause reserving to the United States the right to erect, maintain, and control dikes or other works of improvement upon the property, to remove the same, and to occupy and use so much of said property as may be necessary for these purposes at all times hereafter forever. The board further recommends that said deed shall contain a clause prohibiting the occupation of the property in any manner or by anything which may be in any way dangerous, deleterious, or damaging to any other property of the United States, whether adjoining that conveyed or in its vicinity.

The board has made very careful and thorough inquiry to determine a price to be fixed for this land. The prices of riparian property in the port of Philadelphia and along the shores of the Delaware and Schuylkill rivers vary so greatly with local and commercial conditions that they furnish no satisfactory basis for such a determination. No riparian property in the vicinity of the land in question has been sold during recent years.

This land lies at the junction of the Delaware and Schuylkill rivers, and therefore, if properly improved, may become of great commercial value in the future. On the other hand, it will cost at least $2,000 per acre to raise it to the necessary level above high water. It has no established line of communication with the surrounding country, and the validity of the title has been questioned.

The question as to the validity of the title by which the United States hold this property, to which certain of the papers before the board relate, not being within the scope of the instructions, has not been considered. This uncertainty of title, together with the cost of improvement and the conditions necessarily imposed by the Government, would doubtless greatly reduce the value of the property if offered at public sale.

It appears from official records that about 41.5 acres of riparian land lying adjacent to and just north of the land in question is assessed at $10,000, or about $241 per acre. This land is partly filled and could be utilized for commercial purposes at considerably less expense than that at the mouth of the river.

It should also be remarked that 9.39 acres of the land to be sold lies between the Government dike and the low-water line. This area properly belongs to the river, and can not be utilized for any purpose; indeed, it may be partly removed during the progress of the improvement of the channel. Since the Pennsylvania law gives the riparian owner a title to low-water mark, it seems best to include this land in the sale; but in fixing the price it should not be considered.

The area which can be utilized is about 80 acres. In view of all the circumstances connected with the case the board is of the opinion that $200 per acre is a reasonable price for this land. They therefore recommend that the price be fixed at $16,000.

The board further recommends that, in case the sale contemplated by the act is consummated, the necessary papers of transfer be prepared under the direction of the Department of Justice.

The representatives of the International Navigation Company were informed by the board that they would be permitted to submit their views in writing with reference to the terms and conditions of the proposed transfer, for transmission with this report. A letter from Mr. A. D. Hepburn on this subject, dated August 1, 1893, and received since the completion of this report, is accordingly transmitted herewith.

The letter dated February 6, 1893, from Mr. S. C. Neale, attorney, addressed to the Secretary of War, inclosing papers relative to the sale of land at mouth of Schuylkill River near Fort Mifflin, and the papers inclosed with said letter, are herewith respectfully returned.*

Respectfully submitted.

C. W. RAYMOND,
Major, Corps of Engineers, U. S. A.
C. C. WOLCOTT,
Civil Engineer, U. S. N.
CECIL CLAY,
Chief Clerk, Department of Justice.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

LETTER FROM THE INTERNATIONAL NAVIGATION COMPANY WITH REFERENCE TO THE VALUE OF THE PROPERTY

INTERNATIONAL NAVIGATION COMPANY,
Philadelphia, August 1, 1893.

DEAR SIR: In accordance with the request of the board that we would transmit our views with respect to the value of the property known as Cabin Island, we take pleasure in complying therewith as follows, only regretting that the necessity of obtaining certain data as to the approximate cost of filling in the lands has occasioned some delay.

The subject seems to divide itself as follows: (1) The value of the land generally, and without reference to the question of title of the United States; (2) its value to the United States in view of their defective title, and (3) the advantage of transferring the property to the International Navigation Company as directed by the act of Congress.

I. It is almost impossible to give even a guess upon the value of the property so entirely speculative in its use, and which is so entirely without market value at the present time. The property consists of mud flats, all, with the exception of a half-dozen acres, covered with water at high tide, and is unavailable for any purpose whatever without improvement at enormous expense. No one but some very powerful association can afford to improve the property by diking and filling it up. The approximate cost of such an improvement for the mere filling in of the flats to an elevation of 10 feet above mean high water, at the rate of 10 cents per cubic yard, would be something like the following:

Province Island as bounded by a survey made by W. H. Jones, esq., 1,250,000 cubic yards; cost, $125,000. That part of Cabin Island as bounded by a survey made by W. H. Jones, esq., 2,485,000 cubic yards; cost, $248,500. Wallace tract on Cabin Island, 606,000 cubic yards; cost, $60,600. That portion of Cabin Island exclusive of the Wallace tract and known as the Ashmead tract, 1,879,000 cubic yards; cost, $187,900.

In all, this would amount to $622,000—a sum sufficiently large to deter all but a very limited class of purchasers from acquiring the property. The low-lying banks of the river above high water in the vicinity of these flats have at present no use except for pasturage purposes, and it is difficult even as to them to ascertain values. We know of no sales in the immediate vicinity for many years. All the surrounding fast land could probably be bought at a very low figure. Yet this is land which can be utilized at once, without large expense, for commercial purposes; while, on the contrary, the flats in question are of no use or value to anyone except with a view to improvement at enormous expense, and it is believed there would be no sale for them in the market at all; that is, it is quite clear that if put up for sale they would realize no more than a nominal sum.

II. But, in addition to the fact that at most a nominal sum only could be obtained for these lands in the market, their value to the United States is further diminished, if not entirely destroyed, by the defect in the Government's title. By the brief of facts already filed with your board, it appears that a prior survey, warrant, and patent to the island was granted in 1822 to Wallace, and that the marsh lands patented to Ashmead in 1851, and by him transferred to the United States, are merely the accretions to the original and complete island patented to Wallace and through him now vested in the International Navigation Company.

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* Omitted.

Under the laws of Pennsylvania there can be no doubt that the State had no right in the accretions patented to Ashmead, but these followed the original island patented to Wallace. The authorities are clear.

1. Title to islands in the Delaware River was acquired from the Crown, and afterwards from the States of New Jersey and Pennsylvania, in accordance with a compact made between them in 1783 (see Sargeant's Land Law, 191), and such islands are not subject to the ordinary modes of taking of lands by warrant and survey. (Freytag v. Powell, 1 Wharton, 539.)

The first act authorizing sales of islands in the Delaware River was the act of 27th of January, 1806 (4 Smith Laws, 268; see Lewis on Land Title in Philadelphia, 200). Under this act Thomas K. Wallace, our predecessor in title, filed his application in writing for the island therein mentioned "as lying at the mouth of the Schuylkill River near the upper end of Fort Island and opposite State Island, about one-quarter of a mile southeast from State Island." Under this application a warrant was issued for the survey of the "above-described island," and under this warrant a survey and draft of "an island situate in the Delaware River in Kingsessing Township in the county of Philadelphia, lying at the mouth of the Schuylkill within one-fourth of a mile southeast of State Island," was filed. A patent duly issued dated August 14, 1822, for "all that certain island," following the lines of the survey, and said to contain 21¼ acres, "neat measure." There is no question that the Wallace survey, wherever located, has passed the land mentioned in its courses and distances to the International Navigation Company, and this portion of the present Cabin Island is expressly excepted from the Ashmead or United States survey in 1855.

2. The riparian owner upon a navigable stream owns to low-water mark, subject to the public right of passage for navigation, fishing, and other proper uses of the highway to the mark of ordinary high water, and also to the right of the State to improve the stream as a highway. This same rule applies to the owners of islands in navigable streams. (Pennsylvania Coal Co. v. Winchester, 109 Pa. St., 572.) Therefore, whatever land is exposed at low tide around an island belongs to the owner of the fast land, and a conveyance of the whole island would carry with it the flats, mud banks, and cripple land covered by water at high tide. (Hartley v. Rumford, 81 Pa. St., 478.)

3. The riparian owner is also entitled to the alluvium or gradual accretions which may be deposited upon the banks of a navigable stream. As Prof. Mitchell says in his book on the Law of Real Estate in Pennsylvania, p. 29:

"The accretion or diminution of lands fronting on a large navigable river as a result of the rising or falling of the waters is sometimes considerable, and the fluctuations are frequently quite rapid. The flats along the river front formed by the deposit of earth or sand along the river shore are part of the fast land and belong to the owner. They are said to be appurtenant to the adjoining fast land."

The rule seems to be applied to islands (see Houck on Navigable Rivers, 170), and this even where from the narrowness of the channel the rights of the riparian owner and the island owner to the accretions and fast lands may meet and overlap. In this case it is for the jury to say where the right of one owner ends and the other begins. (Gould on Waters, sections 77 and 166; Fullmore v. Jennings, 78 Cal., 634.)

When, therefore, the State of Pennsylvania undertook to grant these accretions to Ashmead it exceeded its powers, having already granted the right to the same to Wallace by the former patent.

III. The advantages of a sale of this property to the International Navigation Company are apparent. This is probably the only corporation existing in Philadelphia that could or would improve these flats, and thus incidentally greatly assist the navigation of the river and the work of the Government in that respect. If the question of title can be settled, it is hoped by the company to begin the work of improvement as soon as the commerce of Philadelphia will warrant. This company as owner of the Wallace title is the only available purchaser of the Government's title, since it is only by combining the two titles that the property would become available for improvement on the part of anyone.

These are considerations which we are sure will weigh with your board in fixing any figure for this property.

Yours, respectfully,

A. D. HEPBURN,
R. E. and tax agent.
BIDDLE & WARD,
Of Counsel for International Navigation Company.

Maj. C. W. RAYMOND,
Chairman of the Board appointed in re Cabin Island, etc.

APPENDIX NO. 4.

GUN AND MORTAR BATTERIES, SAN FRANCISCO HARBOR, CALIFORNIA.

REPORT OF COL. GEORGE H. MENDELL, CORPS OF ENGINEERS, OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1894.

UNITED STATES ENGINEER OFFICE,
San Francisco, Cal., July 21, 1894.

GENERAL: I have the honor to transmit herewith annual reports on fortifications for the year ending June 30, 1894.

Very respectfully, your obedient servant,

G. H. MENDELL,
Colonel, Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

[Extract.]

MORTAR BATTERY NO. 1.

The amount of concrete made and placed during the year was 7,097 cubic yards. It was made by machinery, with general proportions of 1 part Portland cement, sand 3.46, broken stone and gravel 9.16.

The cost per ton of stone unbroken was $1.03, of gravel $1, and of sand 30 cents. The cost of water per yard of concrete was 5.3 cents, and of cement at the mixer $2.25 per barrel, except for 400 barrels costing $2.57. The cost of concrete in place, including materials, labor, forms, tramway, proportion of cost of setting up plant, tests, and tools, was $4.89 per cubic yard. Adding the quantity put in last year, the amount to June 30 is 7,625 cubic yards.

The masonry was plastered inside and out, for the main structure 54,590 square feet. The arches and exterior faces were painted with bitumen.

Plastering with 1 to 1½ parts of sand cost 3.4 cents per square foot; pavement 9.8 cents, and bitumen paint 1.2 cents.

The electric-light plant cost $1,967.91. It comprises a Mayo dynamo for 80 lamps, an Armington and Sims engine 12-horse power, boiler 15-horse power, with instruments and tools, supplying 68 incandescent lamps. This plant was put in operation, so far as relates to lamp setting and connections, by Lieut. Flagler without technical assistance. There is a masonry water tank in the boiler room with connection of water-supply pipes.

The excavation of the year was 32,324 cubic yards, and cost 39½ cents; a considerable part was in rock. In addition there was borrowed for filling 6,714 yards of loam, and 4,136 cubic yards of sand was borrowed. The loam was used for the outside for support of grass, and the sand was placed over the bitumen paint, clay being objectionable in this place.

The total filling was 44,124 cubic yards. The cost, leaving out sand, was 18.4 cents per yard, and of sand 27 cents.

When the loam was in place it was sown with oats or barley and artificially watered, needed to sustain growth in the dry months.

The slopes bounding two of the mortar pits were sodded at much greater cost, as grass could hardly be relied upon to hold a slope of 3/4 as this particular slope needs to be held.

MISCELLANEOUS ITEMS.

A roadway connecting the old road with mortar pit No. 4 was partly made, uniting with the battery communication to mortar pit No. 2, and partially macadamized.

A spring of good drinking water having been developed in the excavation of mortar pit No. 2, it was bricked up for convenience of the cannoneers.

The water supply for the work was derived from a conduit of Spring Valley Water Company, a private corporation, which supplies the city. It was pumped by steam to tanks upon the hill, from which pipes were led to the concrete mixer and to the masonry tank in the boiler room, and over the earthwork, the last necessary to make the grass grow on the slopes in the dry season.

APPENDIX No. 5.

POST OF WILLETS POINT, NEW YORK—UNITED STATES ENGINEER SCHOOL—BATTALION OF ENGINEERS—ENGINEER DEPOT

REPORT OF LIEUT. COL. W. R. KING, CORPS OF ENGINEERS, FOR THE FISCAL YEAR ENDING JUNE 30, 1894.

UNITED STATES ENGINEER SCHOOL,
Post of Willets Point, New York Harbor, July 10, 1894.

GENERAL: I have the honor to forward herewith duplicate annual report on the post of Willets Point, New York Harbor; the United States Engineer School; the Battalion of Engineers, and the Engineer Depot, for the fiscal year ending June 30, 1894.

Very respectfully, your obedient servant,

W. R. KING,
Lieutenant-Colonel of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

I.—POST OF WILLETS POINT.

At the close of the fiscal year the garrison consisted of 23 commissioned officers and 380 enlisted men, including the following general staff, artillery, and infantry officers:

Maj. Egon A. Koerper, surgeon, U. S. Army.
Capt. Nathan S. Jarvis, assistant surgeon, U. S. Army.
Second Lieut. James Hamilton, Third Artillery.
Second Lieut. Joseph C. Fox, Thirteenth Infantry.
Second Lieut. Isaac C. Jenks, Twenty-fourth Infantry.
Second Lieut. John E. Woodward, Sixteenth Infantry.
Second Lieut. James Ronayne, Ninteenth Infantry.

The following table shows the changes among the general staff and line officers at the post during the year:

Rank and organization.	Name.	Date	Relieved or joined.
Captain, Medical Department	Kendall, William P	May 20, 1894	Relieved.
Second Lieutenant, Fifth Artillery	Jordan, Sidney S	Oct. 1, 1893	Do.
Do	McGlachlin, jr., Edward	Oct. 1, 1893	Do.
Second Lieutenant, Fifth Infantry	Keech, Frank B	Apr. 30, 1893	Relieved; resigned.
Second Lieutenant, Twelfth Infantry	Uline, Willis	Oct. 1, 1893	Relieved.
Second Lieutenant, First Cavalry	Whitman, Walter M	Oct. 1, 1893	Do.
First Lieutenant, Twenty-fifth Infantry	Shattuck, Amos B	May 2, 1894	Do.
Captain, Medical Department	Jarvis, Nathan S	May 19, 1894	Joined.
First Lieutenant, Twenty-fifth Infantry	Shattuck, Amos B	Dec. 4, 1893	Do.
Second Lieutenant, Third Artillery	Hamilton, James	Dec. 1, 1893	Do.
Second Lieutenant, Thirteenth Infantry	Fox, Joseph C	Dec. 23, 1893	Do.
Second Lieutenant, Twenty-fourth Infantry	Jenks, Isaac C	Dec. 4, 1893	Do.
Second Lieutenant, Sixteenth Infantry	Woodward, John E	Dec. 1, 1893	Do.
Second Lieutenant, Nineteenth Infantry	Ronayne, James	Nov. 25, 1893	Do.

BUILDINGS AND OTHER IMPROVEMENTS.

Including the buildings belonging to the fortifications, engineer school, and depot, which are reported on elsewhere, there are about one hundred public buildings on the post. Some of these buildings are of a substantial character, while others are cheap, temporary structures which are gradually being replaced by more permanent buildings.

During the past year the usual minor repairs, such as painting, glazing, roofing, and plastering have been made to the barracks, quarters, and storehouses of the post proper by enlisted men under direction of the post quartermaster, Lieut. Jadwin, who has also supervised the contract work of building new barracks and preparing foundations for quarters No. 10.

The new barracks for Companies B and C, built last year, have been occupied and a new barrack for Company A was well under way at the end of the fiscal year, and will doubtless be ready for occupancy before cold weather. The removal of quarters No. 10 to the opposite side of the parade ground was done by enlisted men under the immediate supervision of Sergt. McManus, and was successfully accomplished while three officers were living in the building. Foundation and basement walls have been built by contract, and the work of replastering, painting, etc., has been nearly completed.

Considerable work has been done by the garrison in extending and repairing roads, sidewalks, gutters, and drains and in grading and macadamizing the company parade grounds. Quite a number of shade trees have been transplanted and the space between barracks and company parade grounds has been sodded.

A quantity of concrete from the foundations of old buildings has been broken up into masses convenient for handling and hauled to the margin of the ice pond for use in building a retaining wall. This wall is very much needed to enable the grading around the pond to be so arranged as to prevent surface water from running into the pond, and also to get rid of the muddy and very unsanitary margin that has long been a menace to the health of the post. A small allotment of funds has been repeatedly asked for to complete this much-needed improvement, but as none has been allowed the work has been undertaken by fatigue parties, and a considerable part of the trench for the wall has been dug; but owing to the extreme heat there is liability to cause malarial fever in the vicinity of the pond at this time, and it may be necessary to suspend operations until frost comes. Although it will only be possible to do a little of this work at a time, it is hoped that it may eventually be completed. The post quartermaster has also done considerable miscellaneous work in tearing down old buildings and clearing up the space occupied by them, in repairing the ice house, preparing the target butts for the annual rifle practice, and in fixing up the old guard house for quarters for the band sergeant.

II.—UNITED STATES ENGINEER SCHOOL.

The scope and object of the school have been fully set forth in previous reports and in the order establishing it on its present basis. The orders issued in pursuance of the latter, arranging the details of the seasons' work, are appended, marked A, B, and C.

During the present year a class of three engineer officers completed the full course of two and one-half years, and four line officers completed their course of torpedo instruction.

Second Lieut. Jay J. Morrow, Corps of Engineers, was relieved from instruction at the U. S. Engineer School January 4, 1894, on being appointed post adjutant, signal and recruiting officer, battalion adjutant and treasurer, commanding Company D, Battalion of Engineers, after having completed over two years of the prescribed course. Second Lieut. John S. Sewell, Corps of Engineers, was also relieved from instruction and assigned to duty under the immediate orders of the chairman of Special Subcommittee on Appropriations, House of Representatives, and of Col. Wilson, Corps of Engineers.

THIRD WINTER'S CLASS—(COURSE COMPLETED.)

Second Lieut. Spencer Cosby, Corps of Engineers.
Second Lieut. Charles P. Echols, Corps of Engineers.
Second Lieut. James F. McIndoe, Corps of Engineers.

SECOND WINTER'S CLASS.

Second Lieut. James B. Cavanaugh, Corps of Engineers.
Second Lieut. James P. Jervey, Corps of Engineers.

FIRST WINTER'S CLASS.

Second Lieut. James Hamilton, Third Artillery.
Second Lieut. Joseph C. Fox, Thirteenth Infantry.
Second Lieut. Isaac C. Jenks, Twenty fourth Infantry.
Second Lieut. John E. Woodward, Sixteenth Infantry.
Second Lieut. James Ronayne, Nineteenth Infantry.
Second Lieut. George P. Howell, Corps of Engineers.
Second Lieut. Charles W. Kutz, Corps of Engineers.
Second Lieut. Meriwether L. Walker, Corps of Engineers.
Second Lieut. Robert P. Johnston, Corps of Engineers.
Second Lieut. Robert R. Raymond, Corps of Engineers.

III.—BATTALION OF ENGINEERS.

The law provides for five companies of Engineer troops, having an aggregate strength of 752 enlisted men, officered by details from the Corps of Engineers.

At present only four companies, with a total strength of 500 enlisted men, are allowed to be recruited.

The aggregate strength of the Battalion of Engineers on June 30, 1894, including Company E, stationed at West Point, N. Y., was 17 commissioned officers and 466 enlisted men.

During the year Companies A, B, and C have been stationed at Willets Point; Company D exists in name only; Company E has been stationed at West Point to assist in the practical instruction of cadets of the Military Academy in building military bridges, sapping, mining, and signaling.

A detachment of 16 noncommissioned officers and privates was sent to Chicago to assist in setting up and exhibiting the engineer models and other exhibits in the Government building at the World's Columbian Exposition, and remained there during the summer. Their conduct and soldierly bearing were such as to win praise from the officers under whose orders they were serving and from numerous civilians who visited the Exposition.

The following is a roster of officers serving with the Battalion of Engineers on June 30, 1894 viz:

Lieut. Col. W. R. King Corps of Engineers, commanding.
Second Lieut. Jay J. Morrow, Corps of Engineers, adjutant.
Second Lieut. Edgar Jadwin, Corps of Engineers, quartermaster.
Company A:
    Capt. Walter L. Fisk, Corps of Engineers, commanding company.

Company A—Continued.
  Second Lieut. Meriwether L. Walker, Corps of Engineers, with company.
  Second Lieut. Robert R. Raymond, Corps of Engineers, with company.
Company B:
  Capt. William T. Rossell, Corps of Engineers, commanding company.
  Second Lieut. James B. Cavanaugh, Corps of Engineers, with company.
  Second Lieut. George P. Howell, Corps of Engineers, with company.
Company C:
  Capt. William M. Black, Corps of Engineers, commanding company.
  Second Lieut. John S. Sewell, Corps of Engineers, on detached service.
  Second Lieut. James P. Jervey, Corps of Engineers, with company.
  Second Lieut. Charles W. Kutz, Corps of Engineers, with company.
  Second Lieut. Robert P. Johnston, Corps of Engineers, with company.
Company D:
  Exists in name only.
Company E:
  Capt. James L. Lusk, Corps of Engineers, commanding company.
  First Lieut. Mason M. Patrick, Corps of Engineers, with company.
  Second Lieut. Charles S. Bromwell, Corps of Engineers, with company.

Second Lieut. Jay J. Morrow, Corps of Engineers, was relieved from duty with Company C, Battalion of Engineers, and appointed adjutant and treasurer, Battalion of Engineers, January 4, 1894, in orders No. 3, Battalion of Engineers, Willets Point, N. Y., January 4, 1894.

Second Lieut. James P. Jervey, Corps of Engineers, was transferred from Company C, to Company A, Battalion of Engineers, July 4, 1893, in orders No. 85, Battalion of Engineers, Willets Point, N. Y., July, 4, 1893, and transferred from Company A, to Company C, Battalion of Engineers, January 23, 1894, in orders No. 16, Battalion of Engineers, Willets Point, N. Y., January 23, 1894.

The following table shows the changes that have taken place in the personnel of the officers during the year:

Rank.	Names.	Date.	Joined or relieved.	Remarks.
Second lieutenant	Deakyne, Herbert	July 3, 1893	Relieved	Special Orders, 140, Adjutant-General's Office, June 21, 1893.
Do	Howell, George P	Sept. 30, 1893	Joined	Special Orders, 145, Adjutant-General's Office, July 8, 1893.
Do	Kutz, Charles W	do	do	Do.
Do	Walker, Meriwether L	do	do	Do.
Do	Johnston, Robert P	do	do	Do.
Do	Raymond, Robert R	do	do	Do.
Captain	Rossell, William T	Nov. 11, 1893	do	Special Orders, 260, Adjutant General's Office, Nov. 10, 1893.
Do	Hoxie, Richard L	Nov. 13, 1893	Relieved	Do.
Second lieutenant	Keller, Charles	Nov. 7, 1893	do	Special Orders 254, Adjutant-General's Office, Nov. 5, 1893.
Do	McGregor, Robert	Dec. 26, 1893	do	Special Orders, 288, Adjutant-General s Office, Dec. 14, 1893.
Do	Cosby, Spencer	June 9, 1894	do	Special Orders, 132, Adjutant-General's Office, June 6, 1894.
Do	Echols, Charles P	do	do	Do.
Do	McIndoe, James F	do	do	Do.

RECRUITING, DISCIPLINE, ETC.

During the year recruits for the battalion have been obtained by enlistments at Willets Point and West Point, and by assignment on their own application from recruiting depots or other branches of the service.

An engineer sergeant detailed to recruit for the Battalion of Engineers on February 17, 1893, and attached by the superintendent recruiting service to rendezvous No. 146 Park Row, New York City, was continued on that duty during the year.

The following is a statement of changes among the enlisted men of the battalion during the past year:

Gain:	
Recruits from depots	26
Enlisted in the battalion (Willets Point, 91; West Point, 20)	111
Reenlisted (Willetts Point, 32; West Point, 7)	39
By transfer	12
From desertion	12
Total gain	200
Loss:	
Discharged by expiration of service	43
for disability	2
by sentence of general court-martial	15
by special order	6
by General Orders 80, Adjutant-General's Office, series of 1890	22
by General Orders 81, Adjutant-General's Office, series of 1890	15
Transferred	18
Retired	3
Died	3
Deserted	25
Total loss	152

This result shows a net gain of 48 men, which increases the battalion to within 34 men of its authorized strength.

During the fiscal year ending June 30, 1894, 60 men of the Battalion of Engineers were entitled to be discharged under the provisions of paragraph 2, General Orders 80, Adjutant-General's Office, 1890, 22 of whom availed themselves of this privilege.

Sixty-two enlisted men were on furlough during the year under the provisions General Orders No. 80, Adjutant-General's Office, 1890.

The following table gives a comparative statement of recruiting, desertions, etc., during the past ten years:

Fiscal year.	Recruiting.		Average daily number.		Deserted.	Trials.			No. of men on June 30.
	Enlisted.	Reenlisted.	Arrest or confinement.	Sick.		General court-martial	Garrison court-martial	Summary court.	
June 30, 1884, to June 30, 1885	56	30	6	18	106	11	59	....	383
June 30, 1885, to June 30, 1886	57	38	8	22	76	20	107	....	396
June 30, 1886, to June 30, 1887	20	28	9	17	49	19	160	....	388
June 30, 1887, to June 30, 1888	9	24	12	22	49	21	218	....	387
June 30, 1888, to June 30, 1889	90	29	6	20	23	4	214	....	402
June 30, 1889, to June 30, 1890	147	64	9	14	52	13	304	....	468
June 30, 1890, to June 30, 1891	50	59	6	12	15	12	60	138	417
June 30, 1891, to June 30, 1892	83	42	5	10	24	19	4	208	437
June 30, 1892, to June 30, 1893	63	31	6	11	17	18	8	156	418
June 30, 1893, to June 30, 1894	111	39	6	13	25	27	4	125	466
Average	68.6	38.4	7.3	15.9	43.0	16.4	113.8	157.	416.2

It will be seen from this table that the number of men enlisted is greater than at any report during the past ten years, except in 1890; that there has been a falling off of 25 per cent in the number of trials for minor offenses, while the number of desertions and trials by general court-martial are about one-half larger than last year. These two items usually depend more upon the number of recruits than upon the strength of the command, and this number was unusually large during the past year.

The numbers of sick and of men in confinement are below the average for the ten years.

The following statement shows the number of different men tried by court-martial and other facts relative to the trials:

	Trials.
By general court	27
By summary court	125
Objected to trial by summary court and tried by garrison court	4
Total	156

	No. of men.	No. of trials.
Tried once	55	55
Tried twice	22	44
Tried three times	9	27
Tried four times	5	20
Tried five times	2	10
Total	93	156

Number of men who pleaded guilty	127
Number of men who pleaded not guilty	29
Total	156
Number of acquittals	6
Number found guilty	150
Total	156

This statement shows that only one-fifth of the men were guilty of any delinquency during the year of sufficient importance to require trial, and that the number of men who were tried more than once during the year was less than in former years.

The question of nativity of the enlisted men in the Army being often misunderstood, the following table relating to the Battalion of Engineers has been prepared, from which it will be seen that 52 per cent were born in this country, and that only 5 per cent have been in this country less than five years:

Battalion of Engineers.

Nationalities.	Noncommissioned staff and band.	Company A.	Company B.	Company C.	Company E.	Total.
United States	5	58	54	46	79	242
Austria		2	3		1	6
Brazil			1			1
Canada		1	1		1	3
Ceylon		1				1
Cuba					1	1
Denmark			1	2		3
England		5	9	7	2	23
France				1		1
Germany	9	9	17	19	8	62
Holland			1	2		3
Ireland	1	30	25	36	4	96
Norway	1	3	1	1		6
Poland		1				1
Russia		1		2		3
Scotland					1	1
South Africa					1	1
Sweden		1	2			3
Switzerland	2	3	2	1		8
Total	18	115	117	117	98	465

In United States.

	Born in United States.	10 years or over.	5 to 10 years.	Less than 5 years.
Noncommissioned staff and band	5	8	4	1
Company A	58	27	24	6
Company B	54	37	18	8
Company C	46	39	25	7
Company E	79	11	6	2
Total	242	122	77	24

Grand total, 465 men.

DRILL AND INSTRUCTION.

During the year the Battalion of Engineers has been drilled and instructed as follows:

1. Infantry tactics: School of the soldier, company, and battalion.

2. Target practice: The practice for the post of Willets Point, New York Harbor, for the past year was from July 3, 1893, to August 30, 1893, and at West Point, N. Y., during the months of May, June and July 1893.

Owing to the objections by the citizens living in the vicinity to the use of the rifle range at this post, no regular target practice could be had. A suitable butt, with targets for firing at short ranges and with reduced charges, built at this post in 1891, was thoroughly repaired during June, 1893.

Target practice was held daily by companies in turn, superintended by the company commanders.

3. Pontoniering during the months of August and September, 1893.

4. Military engineering: Foot reconnoissance, tracing, profiling, and constructing field fortifications, sapping, construction of spar bridges, double lock, including knots and lashings, during the months of October and November, 1893.

5. Torpedo drills were had throughout the year, the winter months being devoted to indoor drills and practice in the loading room, and the summer months in outdoor drills and exercises.

The following number of men received instruction during the winter months, viz, 22 sergeants, 32 corporals, and 287 privates.

One sergeant, 7 corporals of Company E, Battalion of Engineers, were, in detachments of two each, assigned for instruction in torpedo service under authority granted in letter dated Adjutant-General's Office, August 3, 1893.

Qualification of privates:	
First class	266
Second class	21
Total	287

Four men received no instruction during indoor season, viz, 2 men in confinement, and 2 men sick in hospital during entire season.

During the summer months 6 grand groups were planted, which required 6 different details by roster, each detail consisting of 2 commissioned officers, 3 noncommissioned officers, and 12 privates.

6. Photography: Selected details of noncommissioned officers have been instructed in military photography.

7. In order to facilitate the learning of the various industrial trades by enlisted men, and furnish men qualified for special duty as carpen-

ters, blacksmiths, engine-drivers, etc., a detail of 4 men from each company was employed under the supervision of Lieut. James B. Cavanaugh, Corps of Engineers, to act as assistants to the mechanics at work in the different shops on the post, when not on other duty. This duty was voluntary, and the men were allowed to select the trades they were to learn. If they made satisfactory progress, they were considered eligible for special details when vacancies occur, but if not they were replaced by others, and a record was kept of the progress made by each man for future reference.

8. The post schools for the enlisted men and for the children living on the post were under the supervision of Lieut. James B. Cavanaugh, Corps of Engineers, and have been well conducted. Fifty-three enlisted men and 56 children between the ages of 5 and 15 have received appropriate instruction.

The following recommendations made in former reports are respectfully renewed, as experience continues to indicate that the changes recommended are desirable for the best interests of the service, viz:

(1.) A three-years' term of enlistment, with reenlistments for the same period during good behavior and physical fitness.

(2.) A repeal of all complicated laws and regulations authorizing discharges by purchase or otherwise, before expiration of service. The occasional discharge of an enlisted man for the good of the service, or, in special cases, for the benefit of the soldier, as heretofore practiced for many years, appeared to answer all purposes.

(3.) Simplify the rates of pay and allowances, and increase the pay of noncommissioned officers.

(4.) Have check roll-call at 9:30 instead of 11 p. m.

ENGINEER DEPOT.

BUILDINGS, BOATS, ETC.

I. The building for engineer models built by engineer soldiers in 1891, has proved a timely provision for the purpose, as it is now well filled with models, building materials, etc., which, including those received from the World's Columbian Exposition, have been found of the greatest advantage in the instruction of classes in civil and military engineering.

II. A third cable tank has been completed and is now being filled with torpedo cable.

III. An additional quantity of balks and chess have been prepared for ponton bridges, and 6 new canvas ponton covers have been ordered, the frames having been prepared by altering a number of frames that were on hand, but which were larger than required by the Ponton Manual.

The quantity of mooring rope, lashings, etc., has also been increased, and with what has been ordered will be sufficient for any ordinary demand likely to be made on the depot for that class of materials. There will be enough to build 50 bays with boats and trestles, while the surplus of balks and chess which could be floated on rafts of casks or various kinds of boats that can be found on most of our rivers, would extend the bridge to over 2,000 feet in length.

The wagons belonging to the ponton trains are, many of them, still in fair condition, but some of them that were too near the ground are going to decay. Some 700 of them were piled in a large frame building immediately after the war, nearly thirty years ago, and a recent overhauling of a part of the stock discloses the fact that many of those at the bottom of the pile have come in contact with the earth by the rotting away of the timbers on which they were piled. It will be an enormous amount of work to overhaul the entire number, and as it is not likely that more than a quarter of them will ever be needed, even if they were serviceable, it will probably be best to select a sufficient number of those in the best condition and have the rest condemned and sold. The building in which they are stored is a mere shell, in one continuous room, 250 feet long, and from its structure would be entirely consumed in case of fire. I have had the wagons removed from a section near the middle, and it would be an additional precaution to have a brick wall or two built across the building and extended up to and above the roof, so that in case of fire one portion of the building and its contents could be saved.

IV. The furnace in the officers' laboratory having become unserviceable, a steam heater was put in, and in order to avoid the introduction of any magnetic substance in or near the galvanometer room, the radiators were made of the old copper pipes formerly used in the condenser of one of the steamers. The radiators were placed in the second story of the building as well as the first, which was formerly the only one heated.

V. A very important item of depot work has been in receiving the models from the World's Columbian Exposition and unpacking, repairing when necessary, setting up and labeling the models and views. They were received in 3 lots and numbered 177 boxes and packages.

DEPOT PROPERTY AND WORK OF DEPOT.

I. The contract for 50 miles of insulated cable referred to in last report was very much delayed by the difficulty of getting machinery and materials adapted to the manufacture of the special kind of cable required by the specifications, but the cable has finally been made of suitable quality and quantity, and a second contract for 34 miles has been awarded to the same company.

II. The Sims-Edison fish torpedo, after many tests, was finally accepted August, 1893, and a new 2-mile cable was procured for it.

III. A large quantity and variety of engineer property which had become unserviceable was overhauled, inspected, and condemned. This property was the accumulation of a number of years at the depot, some of it having been in use here, and some had been turned in by other officers having such property in charge.

IV. The balance of submarine mining materials on hand and such as could be procured for defense at channels at six places was shipped to these places for storage.

V. A submarine cable was laid across the Narrows between Forts Wadsworth and Hamilton, and having been broken by a ship's anchor it was subsequently taken up and repaired and relaid.

VI. Additions were made to the library of the U. S. Engineer School during the year by purchase of new publications and maps, to the extent of the available appropriation.

INSTRUMENTS.

The various kinds of instruments on hand in the depot have been properly cared for, some additions have been made by purchase, and the work of issuing, receiving, and repairing was continued.

I. Received by purchase during the year under formal proposals, viz:

Seven engineer transits, 3 engineer levels, 10 leveling rods, 5 sextants, 12 binocular field glasses, 12 100-foot metallic tapes, 12 thermometers, 14 odometers, 24 T squares, 12 triangular scales, 14 sets drawing instruments, 1 magnifying glass, 1 beam compass, and 2 drawing pens. Total cost, $2,361.56.

II. Issues to officers of the Corps of Engineers and to acting engineer officers at Department headquarters during the year were as follows:

Ten engineer transits, 8 engineer levels, 7 leveling rods, 1 sextant, 1 reflecting circle, 14 binocular field glasses, 8 aneroid barometers, 15 sets drawing instruments, 20 odometers, 4 silver watches, 1 spyglass, 11 pocket compasses, 2 prismatic compasses, 1 beam compass, 12 scales, 12 protractors, 6 thermometers, 4 heliotropes, 5 100-foot surveyors' chains and pins for same, 3 rain gauges, 1 300-foot steel tape chain, 1 reading glass, 28 triangles, 16 T squares, 5 100-foot steel tapes, 2 drawing pens, and 1 photographic camera.

There were also issued during the year various instruments to surveying parties, composed of details from the Engineer Battalion, for the purpose of making instrumental surveys of certain portions of Long Island, and for hydrographical surveys of the waters in the vicinity of this post.

III. Receipts of instruments from officers on public works and surveys:

Two engineer transits, 2 engineer levels, 2 zenith telescopes, 2 aneroid barometers, and 1 binocular field glass.

IV. Repairs to instruments. All of the repairing to depot instruments has been performed by enlisted men of the Engineer Battalion detailed on extra duty for the purpose. The following have been overhauled and repaired in the depot repair shop, viz:

Eleven engineer transits, 14 engineer levels, 1 theodolite, 1 level rod, 1 reflecting circle, 2 chronometers, 18 pocket compasses, 5 steel tapes, 3 current meters, 4 heliotropes, 3 tripods, 17 prismatic compasses, 1 aneroid barometer, 1 binocular field glass, 1 tide gauge, 2 sets drawing instruments, 1 sextant, 1 standard measure, 2 clocks, 5 galvanometers, 1 wattmeter, 2 voltmeters, 2 switch boards, 1 keyboard, and 12 dial telegraph instruments.

V. The following instruments pertaining to Headquarters Department of Dakota were repaired at St. Paul, Minn., and the cost of repairing paid for from this office, under authority of the Chief of Engineers, U. S. A., viz:

Four engineer transits, 3 chronometers, 2 sextants, 4 prismatic compasses, 2 artificial horizons, 1 beam compass, 1 reflecting circle, and 1 set drawing instruments.

VI. Instruments inspected and condemned. The following instruments, having become unserviceable, were inspected and condemned during the year, viz:

Six chronometers, 3 sextants, 7 artificial horizons, 2 telegraph relays, 10 aneroid barometers, 10 mercurial barometers, 1 wind gauge, 1 psychrometer, 7 thermometers, 5 surveyors' compasses, 7 engineer transits, 6 theodolites, 4 engineer levels, 4 level rods, 1 plane table, 6 tripods, 2 comparators, 10 surveyors' chains, 19 sets pins for the same, 14 tapes (50 and 100 feet long), 35 odometers, 1 boat compass, 29 prismatic compasses, 3 box compasses, 13 pocket compasses, 2 hand levels, 1 Jacob's-staff level, 1 pocket sextant, 2 watches, 18 protractors, and 14 sets drawing instruments.

In this connection I would respectfully invite attention to the fact that some additional precautions are needed to prevent undue loss and damage to instruments from carelessness or ignorance on the part of those who use, or rather misuse, them in the service.

Great care has been taken to procure the most serviceable instruments for the various purposes, and it is well known that a good transit or box of drawing instruments will last a lifetime if properly taken care of. It is seldom, however, that either surveying or drawing instruments once issued from the depot are ever returned in a serviceable condition, no matter how short a time they have been in use. It is no uncommon thing to see valuable instruments, such as transits and levels, returned after only a few months' service in a state of complete wreck. Drawing instruments are seldom returned at all, and never in a serviceable condition. They frequently bear evidence of having been used to clean pipes, or as substitutes for corkscrews in opening bottles.

This difficulty is not one of recent origin, and allowance must be made for the rough nature of the service for which instruments are sometimes needed; but it would be a good thing for the service if all officers who present instruments for condemnation in a discreditable condition, were required to give an account of the circumstances under which the instruments were rendered unserviceable.

It would also be for the benefit of the service if every officer were required to procure a small case of drawing instruments for his own use. A fairly good pocket set can be procured for $5 or $6, and I understand that all cadets at the Military Academy are now required to pay three or four times that sum for the instruments they are required to buy, and which, if properly taken care of, will last as long as the officer remains on the active list. It would therefore be no hardship to require all officers to furnish their drawing instruments in the same way as they do their swords and spurs.

EXPERIMENTS.

In addition to the usual laboratory work pertaining to the torpedo drill, such as testing cables, connecting wires, fuses, etc., other experiments have been made during the year, among which were the following:

I. In destroying two old concrete platforms for 15-inch guns, and the foundations of several other structures also of concrete, the charges were so located and the quantity of explosive was so adjusted as to give some information relative to the use of high explosives for purposes of demolition. A large number of charges were fired and several kinds of explosives were tried. The concrete was of good quality, but it was incidentally noticed that even when carefully laid, concrete is not strictly a monolith, as is generally supposed, but that it naturally divides at the surfaces where the work has been stopped and started again. In some cases a wall 2 feet thick would break off in a perfectly smooth plane cleavage for a distance of 15 or 20 feet.

It was found that a charge of 1 pound of dynamite, or its equivalent, would break a concrete slab 18 inches thick, the charge being placed under the concrete and tamped by the earth upon which the concrete rested, and as this was done without throwing splinters, the indications are that the charge was just right.

II. Numerous tests of sensitiveness and explosive force of several varieties of explosive gelatine, maximite, smokeless powder, and dynamite were made, and granulated gun cotton that had been in the magazine for many years and had absorbed moisture until it would not explode with the service fuse, was found to have recovered its explosive properties by simply allowing it to dry in a small frame magazine.

III. Experiments with the Sims-Edison torpedo up to May, 1893, to determine whether it should be accepted under the terms of the contract, having developed the fact that certain requirements of the specifications as to quantity of cable delivered, etc., had not been complied with, the torpedo was not finally accepted until August. A new cable 2 miles long having been procured, a series of 31 runs and dock trials were made, the report of which was forwarded to the Chief of Engineers, U. S. Army, in February last.

IV. A number of experiments were made during the year under direction of Capt. Hoxie, with a modified system for operating submarine mines devised by him, and a report was forwarded to the Chief of Engineers, U. S. Army, with my monthly report for September.

V. A new form of surveyors' transit, having a micrometer tangent screw, devised by Mr. E. H. Hinton and made by Mr. F. E. Brandis, was tested at the request of those gentlemen by Capt. Black and Lieut. Cosby, U. S. Engineers, to ascertain its adaptability for the engineer service.

A current meter, which was also procured from Mr. Brandis, was tested, and several improvements were made in it at the suggestion of Capt. Black and officers under his direction.

VI. Several tests were made with building materials, including samples of stone from West Virginia, furnished by Col. Craighill, Corps of Engineers, and paving brick forwarded by the Kanawha Brick Company, at Charleston-Kanawha, W. Va.

VII. A number of charges of dynamite were exploded to gain some further information on the subject of sympathetic explosions, but the results were not sufficiently decisive to justify any definite conclusions without further trials.

VIII. The question as to which end of a torpedo should be ignited, the end *toward* or *from* the object to be destroyed, was investigated by two sets of experiments. Six charges of about 5 pounds each and six of 10 pounds were exploded, each charge being about 3 feet long. Three of each charge had the fuse at the end nearest the pressure gauge, and fuses of the others were at the end furthest from the gauge. In case of the smaller charges the pressures were too small to register distinctly on the lead cylinders used, but with the 10-pound charges the results indicated a slight advantage in favor of igniting at the more distant end of the charge. The apparent advantage was about 9 per cent; but the question is of sufficient importance to justify still further experiments and with larger charges to see whether these conclusions are verified.

STATEMENT OF FUNDS.

I. *Engineer Depot at Willets Point, N. Y.*—Congress appropriated for the fiscal year ending June 30, 1894:

1. For incidental expenses of depot (incidentals)	$4,000.00
2. For purchase of materials for instruction of battalion (materials)	3,500.00
3. For purchase and repair of instruments (instruments)	3,000.00
4. For purchase and binding of professional works of recent date treating of military and civil engineering (library)	500.00
Total	11,000.00

Of this there has been expended and pledged:

1. For incidental expenses of depot (incidentals)	$4,000.00
2. For purchase of materials for instruction of battalion (materials)	3,122.80
3. For purchase and repair of instruments (instruments)	2,989.57
4. For purchase and binding of professional works of recent date treating of military and civil engineering (library)	500.00
Total	10,612.37

Congress appropriated under the act of February 24, 1891, for the engineer depot at Willets Point, N. Y., the sum of $16,000, which was assigned to me for disbursement and is available until expended:

6. For a fireproof building to replace engineer depot storehouse destroyed by fire May 10, 1890 (storehouse)	$16,000.00
July 1, 1893, balance unexpended	2,931.21
July 1, 1894, balance unexpended	2,931.21
July 1, 1894, balance available	2,931.21

The following allotments from the several appropriations named have been assigned to me for disbursement and remain available until expended:

II. *Torpedoes for harbor defense* (act September 22, 1888), $98,000.00.

July 1, 1893, balance unexpended	$5,000.00
July 1, 1894, balance unexpended and available	5,000.00

III. *Torpedoes for harbor defense* (act March 2, 1889):

1. The act of Congress making appropriations for fortifications, etc., appropriated under the general title "Torpedoes for harbor defense," the sum of $250,000 for purchase of submarine mines and necessary appliances, and $30,000 for torpedo experiments and instruction of engineer troops in submarine mining—

July 1, 1893, balance unexpended	$15,022.60
June 30, 1894, amount expended during fiscal year	6,301.88
July 1, 1894, balance unexpended	8,717.72
July 1, 1894, outstanding liabilities	726.36
July 1, 1894, balance available	7,991.36

2. For purchase of movable submarine torpedoes	25,225.00
July 1, 1893, balance unexpended	1,375.00
June 30, 1894, amount expended during fiscal year	1,375.00

3. For construction of concrete tanks for wet storage of mining cable, amount allotted	5,000.00
July 1, 1893, balance unexpended	1,965.27
June 30, 1894, amount expended during fiscal year	209.20
July 1, 1894, balance unexpended	1,756.07
July 1, 1894, outstanding liabilities	578.40
July 1, 1894, balance available	1,177.67

IV. *Torpedoes for harbor defense* (act August 18, 1890).

1. For submarine mines and necessary appliances for storage at sundry points	$100,000.00
July 1, 1893, balance unexpended	1,608.15
July 1, 1894, outstanding liabilities	1,528.25
July 1, 1894, balance available	81.90

2. For continuing torpedo experiments, etc	30,000.00
July 1, 1893, balance unexpended	22,990.70
July 1, 1894, balance unexpended and available	22,990.70

V. *Torpedoes for harbor defense* (act February 24, 1891).

For submarine mines and necessary appliances for storage at sundry points	$21,605.00
July 1, 1893, balance unexpended	83.70
June 30, 1894, amount expended during fiscal year	83.70

VI. *Torpedoes for harbor defense.*—For purchase of American manufactured submarine torpedo cable. The following amounts were allotted from balances of torpedo appropriations withdrawn under date of February 13, 1892, viz:

1. From act of March 2, 1889	$49,859.26
2. From act of August 18, 1890	25,101.86
	74,961.12
July 1, 1893, balance unexpended	74,961.12
June 30, 1894, amount expended during fiscal year	13,739.71
July 1, 1894, balance unexpended	61,221.41
July 1, 1894, amount covered by uncompleted contracts	61,221.41

VIII. *Board of Ordnance and Fortification* (act February 24, 1891).

For establishing direct telegraphic communications between Forts Wadsworth and Hamilton, N. Y	1,275.00
September 12, 1893, amount allotted	1,275.00
March 22, 1894, amount withdrawn	848.70
June 30, 1894, amount expended to end of fiscal year	426.30
	1,275.00

NEW APPROPRIATIONS.

The following items have been appropriated for the engineer depot at Willets Point, N. Y., for the fiscal year ending June 30, 1895:

1. For incidental expenses of depot (incidentals)	$4,000.00
2. For purchase of materials for instruction of battalion (materials)	3,500.00
3. For purchase and repair of instruments (instruments)	2,000.00
4. For purchase and binding of professional works of recent date, treating of military and civil engineering (library)	500.00
Total	10,000.00

ESTIMATES.

There will be required for the fiscal year ending June 30, 1896, the following for the engineer depot at Willets Point, N. Y.:

1. For incidental expenses of depot, including fuel, light, chemicals, stationery, hardware, extra-duty pay to soldiers necessarily employed for periods not less than ten days as artificers on work in addition to and not strictly in the line of their military duties, such as carpenters, draftsmen, blacksmiths, printers, photographers, lithographers, engine drivers, wheelwrights, masons, teamsters, machinists, painters, overseers, and laborers, and for materials to repair public buildings, machinery, and unforeseen expenses	$5,000.00
2. For purchase of materials for the instruction of engineer troops at Willets Point, N. Y., in their special duties as sappers and miners, for land and submarine mines, pontonier and torpedo drill and signaling.	500.00
3. For purchase and repair to instruments to be issued to officers of the Corps of Engineers, and to officers detailed on duty as acting engineer officers, for use on public works, surveys, and reconnaissances	3,000.00
4. For library of engineer school: For purchase and binding of professional works of recent date, treating of military and civil engineering and kindred scientific subjects	500.00
Total	9,000.00

APPENDIX A.—PROGRAMME OF STUDY AND INSTRUCTION FOR SUMMER SEASON.

[Printed Orders No. 115.]

UNITED STATES ENGINEER SCHOOL,
Willets Point, New York Harbor, May 29, 1893.

The following programme of study and instruction for the ensuing summer season, to commence June 1 and end November 14, 1893 (24 weeks), having been recommended by the Academic Staff and approved by the Chief of Engineers, will be carried into effect.

A roster of the student officers will be kept by the post adjutant, who will make weekly details for the various duties so that they shall not conflict.

I. MILITARY ENGINEERING.

1. Practical instructions by the company officers in the nomenclature, dimensions, and construction of modern field and siege batteries and saps. Also practical instructions in the location of works on irregular ground and the adaptation to site.
2. A full course of trestle and ponton bridge drill.
3. Instruction in building spar bridges.
4. Instruction in military mining.
5. Military map making. Each lieutenant of engineers, who has not already done so, and such noncommissioned officers and privates as may be selected from each company, will make satisfactory foot reconnaissances about 4 miles long, in the vicinity of the post, the maps thereof to be submitted by company commanders to post headquarters on or before November 14, 1893.

II. TORPEDO DRILLS.

6. After receiving such preliminary practice as may be necessary to acquaint them with the practical details of preparing and planting a torpedo, the officers of the torpedo class will be divided into details of at least two officers each, for the purpose of taking charge of the preparation and planting of a grand group of torpedoes, under the direction of the instructor in torpedoes, assisted by one engineer officer of the second or third winter's class.
7. The senior officer will be in general charge, and will keep a daily journal of operations, noting particularly any difficulties encountered and any suggestions that may occur to him, looking to the avoidance of similar difficulties in the future.
8. The officers will frequently interchange duties so that each one shall have some experience in each part of the drill.
9. The electric light will be set up and operated.
10. The grand group being completed and the search light in position, the post commander will order an exhibition drill illustrating the operations of the torpedo defense against an attempted passage of the mine field by an enemy's vessel under cover of night.
11. The group will then be taken up by the same detail and the parts dismantled, cleaned, and conveniently grouped for the inspection of the instructor.
12. The detail will be instructed and exercised in automatic and judgment firing drills at such times as may be most convenient before the final exhibition drill.
13. The detail of enlisted men for each grand group drill will consist of 3 noncommissioned officers and about 12 privates.
14. The hours of work will be from 7 to 11:30 a. m., and from 1 to 4:30 p. m. In bad weather, when no work is done and the men are in barracks, the latter will attend the same company duties and roll calls as daily duty men.
15. Weekly reports of progress will be rendered by the senior officer of the detail, and at the conclusion of the work each officer will submit a report of the work done by him, mentioning difficulties encountered and any suggestions he may desire to make.
16. A detailed record will be kept of what each man does with the view of tracing out the author of defective work and determining the degree of proficiency developed by individual members of the detail. An account of the character of work done by each man will be submitted by the senior officer with his final report.
17. Occasionally, if practicable, loaded mines will be planted and fired as in actual service, height of jet, effect on neighboring mines and other phenomena being carefully observed and recorded.
18. At such times as will not interfere with the drills above mentioned, the officers of the class will make practical experiments in calibrating commercial ammeters and voltmeters, testing efficiency of dynamos and motors.

III. CIVIL ENGINEERING.

19. A topographical survey of about one-half square mile of ground by each officer of the first summer's class. Time allotted, five weeks.

20. A hydrographic survey of about one-quarter square mile by each officer of the second summer's class. Time allotted, four weeks.

21. While engaged in the field work in topographical and hydrographic surveys the officers will be assisted by details of enlisted men, and will be excused from all other duties.

IV. FIELD ASTRONOMY.

22. All the lieutenants of engineers who have not already completed the course and been excused from further observations will constitute the observers.

23. Officers wishing to use the instruments for special observations or practice must apply for authority to do so, and are not permitted to handle any instruments unless specifically assigned to them by the instructor.

24. In case of damage to instruments or apparatus, it will be promptly reported to the instructor for the action of a board of survey.

25. The following will be the ordinary routine of observations with the several instruments, after reasonable proficiency has been attained by preliminary practice.

Sextant.—After becoming skillful in the use of this instrument upon the sun, observers will deduce at least one satisfactory latitude by observing a north and a south star, using the time deduced from an east and a west star—each based on ten altitudes taken on the same night. These observations for latitude and time must be made at the observatory. The observer may get "time" from an assistant using a portable chronometer and will determine, by comparison, the error of standard chronometer at observatory.

Chronograph.—Daily determination, by time signal from Washington, D. C., of error and rate of astronomical clock, by the officer of the day.

Transit.—A satisfactory set of time observations will be taken by each officer on two nights, successive if possible, determining satisfactorily the error of sidereal clock. The junior class will employ the eye and ear method; the senior class will use the chronograph.

Zenith telescope.—Observers will first determine the level correction by daylight, using a distant terrestrial object, or at night using a slow circumpolar star. They will then find the value of a turn of the micrometer by observing Polaris at elongation. Lastly they will observe for latitude, until they have obtained a satisfactory determination.

26. Suitable blank forms will be provided, both for observations and computations; and all problems must be submitted, complete in every detail, upon these forms. The original records, after inspection by the commanding officer, will be returned to the officers as their personal property.

27. Hours of attendance at the observatory will be, for both classes, daily except Saturday and Sunday, from 8 to 10 a. m., from 2 to 4 p. m., and from 8 to 10 p. m. Evening hours will be extended when it is necessary to secure complete sets of observations.

V. MILITARY PHOTOGRAPHY.

28. The officers' laboratory will be opened daily from 1:30 p. m. to 4 p. m.

29. The building, apparatus, chemicals, etc., will be under the charge of the battalion quartermaster, whose duty it is to furnish any desired assistance, and who will be held responsible for the judicious use of the property.

30. Officers are invited to avail themselves of the advantages of the laboratory, making such arrangements with the officer in charge as shall insure no confusion in his official duties, or in those of the men under his instruction.

31. The instruction of enlisted men will be restricted to a weekly detail of one noncommissioned officer from each company.

32. The battalion quartermaster will submit to this office weekly reports showing the nature of the instruction given, the results attained, and the progress made.

By order of Lieut. Col. King:

ROBERT MCGREGOR,
Second Lieutenant of Engineers, Post Adjutant.

APPENDIX B.—PROGRAMME OF STUDY AND INSTRUCTION FOR WINTER SEASON.

[Printed Orders, No. 242.]

UNITED STATES ENGINEER SCHOOL,
Willets Point, New York Harbor, November 29, 1893.

1. The following programme of study and instructions for the ensuing winter season, commencing December 1, 1893, and ending May 31, 1894, having been recommended by the academic staff and approved by the Chief of Engineers, will be carried into effect.

COURSE FOR OFFICERS.

1. Details of student officers for academic duty will be made weekly by the post adjutant. Officers will devote six hours daily to such duty, Saturdays and Sundays excepted, and excepting time consumed in sessions of general courts martial. Each officer will record daily, in a book provided for that purpose, the disposition of his time for the previous day. Instructors will meet their classes at least weekly for assignment of lessons and examinations. As far as needful they will supplement the course with lectures. Examinations by the academic staff will be held about the end of February and of May. Marks at all examinations will be on the West Point system, and the results will be reported weekly to the commandant of the school.

FIRST WINTER'S COURSE.

2. The course for engineer officers spending their first winter at the school will be: Electricity and torpedoes, twenty-one weeks; surveying, three weeks. For officers of other arms of the service detailed for special instruction in the torpedo service: Electricity and torpedoes, twenty-four weeks.

ELECTRICITY.

3. Study of, in its application to torpedo warfare, arc and incandescent lighting, and transmission of power, supplemented by extensive laboratory practice in the solution of the special problems involved. Text-books and books of reference, as follows: Abbot's Notes on Electricity; Ayrton's Practical Electricity; Thompson's Electricity and Magnetism; Maier's Arc and Glow Lamps; Swinburne's Practical Electrical Measurements; Kapp's Electrical Transmission of Energy; Part II of Professional Papers No. 23, Corps of Engineers, U. S. Army; Gray's Absolute Measurements, Vol. II; Monroe and Jamieson's Pocket Book of Electrical Rules and Tables; Thompson's Dynamo Electric Machinery.

TORPEDOES.

4. Text-book: The Torpedo Manual. Practice will be had in making all the adjustments and tests required in planting and operating torpedoes, the operations on the water being simulated as far as practicable by special indoor appliances. Books of reference: Bucknill's Submarine Mines and Torpedoes as Applied to Harbor Defense; Scheidnagel's Treatise upon Defensive Submarine Mining.

5. Attendance at the electrical laboratory will be regulated by the instructor. All laboratory work will be done without the use of text books, or text book diagrams. Officers may however use manuscript notes or diagrams previously prepared. Laboratory practice will be had from 9 a. m. to 12 m., and from 1 to 4 p. m. During the last two weeks of the course each engineer officer will prepare a plan (map and memoir) for the defense of such harbor as may be designated by the instructor, special attention being given to the torpedo defense and the batteries protecting the torpedo lines.

SURVEYING.

6. Subjects: (1) Adjustment, use and care of instruments; (2) topographical surveying with transit and stadia; (3) hydrographic surveying and gauging of rivers; (4) geodetic surveying; (5) railway surveying. Text books: Johnson's Theory and Practice of Surveying; Henck's Field Book for Engineers.

SECOND WINTER'S COURSE.

7. Civil engineering, seven weeks; military engineering, eight weeks; photography, five weeks; torpedoes, four weeks.

CIVIL ENGINEERING

8. Subjects: (1) Improvement of non-tidal rivers; (2) improvement of tidal rivers; (3) canals; (4) building superintendence.

9. Text-books: Engineer School Notes; selections from Harcourt's Rivers and Canals; Schlichting's Improvement of Non-Tidal Rivers; Annual Reports of the Chief of Engineers, U. S. Army; Transactions American Society of Civil Engineers; Hodges' Mitering Lock Gates; Baker's Masonry Construction; Clark's Building Superintendence. Books of reference (see third winter's course).

MILITARY ENGINEERING.

10. Subjects: (1) Modern guns, carriages and projectiles; (2) steel, compound, wrought and cast iron armor; (3) modern ships of war and seacoast defenses; (4) modern fortification and their attack and defense.

11. Text-books—such parts of the following books as may be designated by the academic staff: Woolwich Text Book of Fortifications; Maguire's Attack and Defense of Coast Fortifications; Fortifications of To-Day; Inglis' paper in Professional Papers Royal Engineers, 1884, and a lecture on armored defense in Ordnance Notes No. 151; Very's Development of Armor; Naval Intelligence Papers, June, 1886; Adams' Spezia Experiments, 1886; Baylay's Types of Modern Guns; Abbot's Lectures on Sea Coast Defense; Professional Papers No. X of U. S. Engineer School of Application.

12. Books of reference: Articles on Fortification and Gunnery, Encyclopædia Britannica; Ordnance Notes No. 135 and Appendix; vol. 9, Professional Papers, Royal Engineers; Report of Board on Fortifications; McKinlay's Text Books on Gunnery; Brassey's Naval Annual, 1887.

MILITARY PHOTOGRAPHY.

13. Practice will be had in the following methods: Negatives by dry process; developers and intensifiers; silver printing, and finishing and mounting of prints; map printing by the blue process and on bromide paper. Each officer to submit for examination: Two landscapes; negatives, silver and blue prints; two photographic copies; negatives, silver and blue prints; negative of map, with three blue and three bromide prints. Text-books: Griffin's Notes on Photography; von Sothen's The Development of the Latent Image on Gelatino-Bromide of Silver; Reed, chapter on Photography applied to Topographical Sketching.

TORPEDOES.

14. Under the direction of the Instructor in Submarine Mining, the instruction of enlisted men in the duties in the loading room and the boat service.

THIRD WINTER'S COURSE.

15. Civil Engineering, eleven weeks; Military Engineering, eight weeks; Torpedoes, five weeks.

CIVIL ENGINEERING.

16. Subjects: (1) Wave and current action, and improvements of harbors; (2) Estimates; (3) Road-making; (4) Mechanism; (5) Steam engines and pumps; (6) Office methods.

17. Text-books: Selections from Harcourt's Harbors and Docks; Annual Reports of Chief of Engineers, U. S. Army; Transactions American Society Civil Engineers, Whitham's Constructive Steam Engineering; Schwamb's Elements of Mechanism; Byrne's Highway Construction.

18. Books of reference: Trautwine's Engineers Pocket-Book; Bixby's Point de Grave; Whitham's Constructive Steam Engineering; Thurston's Manual of the Steam Engine; Ruffner's Improvement of Non-Tidal Rivers; Stevenson's Canal and River Engineering; Billings's Ventilation and Heating; Reuleaux's Kinematics of Machinery.

MILITARY ENGINEERING.

19. Gen. Derrécagaix's "Modern War," and preparation of project for the defense of such place as may be designated by the instructor.

TORPEDOES.

20. Under the direction of the Instructor in Submarine Mining, the instruction of enlisted men in the duties in the loading room and the boat service.

COURSE FOR ENLISTED MEN.

INSTRUCTION OF ENLISTED MEN IN TORPEDOES.

21. Instruction will comprise telegraphing with the dial instrument, including the code for action, and practice in the Morse system of telegraphy; the duties of the loading room and, so far as practicable, of the boat service as prescribed in the Torpedo Manual. They will also receive from the instructor in torpedoes, or his assistant, lectures respecting the fuses, explosives, torpedo material (except that of the operating room), voltaic batteries, simple electrical testing, and the use of the portable apparatus for the electrical ignition of mines.

The "unit" detail for this instruction will consist of 1 noncommissioned officer and 4 privates. Six such details will be kept under instruction. As soon as a man has had his work accepted, i. e., has received a rating of "2.5," he will be excused from further attendance, and in case he has shown a commendable amount of skill and intelligence in his duties, he will be a candidate for such special privileges as it may be deemed expedient to give him. A soldier qualifying twice as "2.5" will be excused from further detail during the winter season.

Recruits on their first detail will be kept under instruction indefinitely until they have done each task at least twice and have received a rating of at least "2.0." They will then be placed on the same footing as old soldiers for further details.

An officer from the second or third winter's class, detailed each week, will be in immediate charge, frequently inspecting the work of the several details. He will make it a special object to note the character of instruction given by the noncommissioned officers, who should know their duties well, and who should be held to a strict account for any defective work that their details may do. He will rate the men as they complete their tasks by a detailed examination of their finished work and a more or less detailed course of questioning. In determining a man's "mark" regard will be had to the degree of intelligence displayed, as well as to the mechanical skill with which the work has been done. At the close of each week he will submit a "proficiency" report of the detail and state what verbal or other instruction was given during the week.

INSTRUCTION OF ENLISTED MEN IN PHOTOGRAPHY.

22. Two noncommissioned officers will be detailed each week for instruction in photography. Practice will be had in the following methods: Negatives by dry process; developers and intensifiers; silver printing, and finishing and mounting of prints; map-printing by blue process and on bromide paper.

II. The following assignment of instructors is made:

Military Engineering: Capt. Wm. T. Rossell, Corps of Engineers.
Civil Engineering: Capt. Wm. M. Black, Corps of Engineers.
Submarine Mining: Capt. W. L. Fisk, Corps of Engineers.
Military Photography: Second Lieut. Edgar Jadwin, Corps of Engineers, battalion quartermaster.

By order of Lieut. Col. King:

ROBERT MCGREGOR,
Second Lieutenant of Engineers, Post Adjutant.

APPENDIX C.—PROGRAMME OF STUDY AND INSTRUCTIONS FOR SUMMER SEASON.

[Printed Orders, No. 112.]

UNITED STATES ENGINEER SCHOOL,
Willets Point, New York Harbor, May 23, 1894.

The following programme of study and instruction for the ensuing summer season, to commence June 4 and end November 30, 1894, having been recommended by the Academic Staff and approved by the Chief of Engineers, will be carried into effect.

A roster of the student officers will be kept by the post adjutant, who will make weekly details for the various duties, so that they shall not conflict.

I. MILITARY ENGINEERING.

1. Practical instructions in the nomenclature, dimensions, and construction of modern field and siege batteries and saps. Also practical instructions in the location of works on irregular ground and the adaptation to site.
2. A full course of trestle and ponton bridge drill.
3. Instruction in building spar bridges.
4. Instruction in military mining.

5. Military map-making. Each lieutenant of engineers, who has not already done so, and such non-commissioned officers and privates as may be selected from each company, will make satisfactory foot reconnaissances about 4 miles long, or a reconnaissance of position of equivalent area, in the vicinity of the post, the maps thereof to be submitted by company commanders to post headquarters on or before November 30, 1894.

II. TORPEDO DRILLS.

6. After receiving such preliminary practice as may be necessary to acquaint them with tne practical details of preparing and planting a torpedo, the officers of the torpedo class will be divided into details of at least 2 officers each, for the purpose of taking charge of the preparation and planting of a grand group of torpedoes, under the direction of the instructor in torpedoes, assisted by 1 engineer officer of the second or third winter's class.

7. The senior officer will be in general charge, and will keep a daily journal of operations, noting particularly any difficulties encountered and any suggestions that may occur to him, looking to the avoidance of similar difficulties in the future.

8. The officers will frequently interchange duties, so that each one shall have some experience in each part of the drill.

9. The electric light will be set up and operated.

10. The grand group being completed and the search light in position, the post commander will order an exhibition drill illustrating the operations of the torpedo defense against an attempted passage of the mine field by an enemy's vessel under cover of night.

11. The group will then be taken up by the same detail and the parts dismantled, cleaned, and conveniently grouped for the inspection of the instructor.

12. The detail will be instructed and exercised in automatic and judgment firing drills at such times as may be most convenient before the final exhibition drill.

13. The detail of enlisted men for each grand group drill will consist of 3 non-commissioned officers and about 12 privates.

14. The hours of work will be from 7 to 11:30 a. m., and from 1 to 4:30 p. m. In bad weather, when no work is done and the men are in barracks, the latter will attend the same company duties and roll calls as daily-duty men.

15 Weekly reports of progress will be rendered by the senior officer of the detail, and at the conclusion of the work each officer will submit a report of the work done by him, mentioning difficulties encountered and any suggestions he may desire to make.

16. A detailed record will be kept of what each man does, with the view of tracing out the author of defective work and determining the degree of proficiency developed by individual members of the detail. An account of the character of work done by each man will be submitted by the senior officer with his final report.

17. Occasionally, if practicable, loaded mines will be planted and fired as in actual service, height of jet, effect on neighboring mines, and other phenomena being carefully observed and recorded.

18. At such times as will not interfere with the drills above mentioned the officers of the class will make practical experiments in calibrating commercial ammeters and voltmeters, testing efficiency of dynamos and motors.

III. CIVIL ENGINEERING.

19. A topographical survey of about one-half square mile of ground by each officer of the first summer's class. Time allotted, five weeks.

20. A hydrographic survey of about one-quarter square mile by each officer of the second summer's class. Time allotted, four weeks.

21. While engaged in the field work in topographical and hydrographic surveys the officers will be assisted by details of enlisted men, and will be excused from all other duties.

IV. FIELD ASTRONOMY.

22. All the lieutenants of engineers who have not already completed the course, and been excused from further observations, will constitute the observers.

23. Officers wishing to use the instruments for special observations or practice must apply for authority to do so, and are not permitted to handle any instruments unless specifically assigned to them by the instructor.

24. In case of damage to instruments or apparatus, it will be promptly reported to the instructor for the action of a board of survey.

25. The following will be the ordinary routine of observations with the several instruments, after reasonable proficiency has been attained by preliminary practice:

Sextant.—After becoming skillful in the use of this instrument upon the sun, observers will deduce at least one satisfactory latitude by observing a north and a south star, using the time deduced from an east and a west star, each based on ten altitudes taken on the same night. These observations for latitude and time must be made at the observatory. The observer may get "time" from an assistant using a portable chronometer, and will determine, by comparison, the error of standard chronometer at observatory.

Chronograph.—Daily determination by time signal from Washington, D. C., of error and rate of astronomical clock, by the officer of the day.

Transit.—A satisfactory set of time observations will be taken by each officer on two nights, successive if possible, determining satisfactorily the error of sidereal clock. The junior class will employ the eye and ear method; the senior class will use the chronograph.

Zenith telescope.—Observers will first determine the level correction by daylight, using a distant terrestrial object, or at night using a slow circumpolar star. They will then find the value of a turn of the micrometer by observing Polaris at elongation. Lastly, they will observe for latitude, until they have obtained a satisfactory determination.

26. Suitable blank forms will be provided, both for observations and computations; and all problems must be submitted, complete in every detail, upon these forms. The original records, after inspection by the commanding officer, will be returned to the officers as their personal property.

27. Hours of attendance at the observatory will be regulated by the instructor.

V. MILITARY PHOTOGRAPHY.

28. The course in military photography for lieutenants of engineers spending their first winter at the post will be five weeks. Practice will be had in the following methods: Negatives by dry process; developers and intensifiers; silver printing, and finishing and mounting of prints; map printing by the blue process and on bromide paper. Each officer to submit for examination: 2 landscapes; negatives, silver and blue prints; 2 photographic copies; negatives, silver and blue prints; negative of map, with 3 blue and 3 bromide prints. Text books: Griffin's Notes on Photography; von Sothen's The Development of the Latent Image on Gelatino-Bromide of Silver; Reed, chapter on Photography applied to Topographical sketching.

29. The building, apparatus, chemicals, etc., will be under the charge of the battalion quartermaster, whose duty it is to furnish any desired assistance, and who will be held responsible for the judicious use of the property.

30. Officers are invited to avail themselves of the advantages of the laboratory, making such arrangements with the officer in charge as shall insure no confusion in his official duties or in those of the men under his instruction.

31. The instruction of enlisted men will be restricted to a weekly detail of 1 noncommissioned officer. Each noncommissioned officer taking the course will submit 6 specimens of his own work for examination.

32. The battalion quartermaster will submit to this office weekly reports showing the nature of the instruction given, the results attained, and the progress made.

By order of Lieut.-Col. King.

Jay J. Morrow,
Second Lieutenant of Engineers, Post Adjutant.

RIVERS AND HARBORS, ETC.

APPENDIX A.

IMPROVEMENT OF RIVERS AND HARBORS IN MAINE AND NEW HAMPSHIRE.

REPORT OF LIEUT. COL. PETER C. HAINS, CORPS OF ENGINEERS, OFFICER IN CHARGE FOR THE FISCAL YEAR ENDING JUNE 30, 1894, WITH OTHER DOCUMENTS RELATING TO THE WORKS.

IMPROVEMENTS.

1. St. Croix River, Maine.
2. Lubec Channel, Maine.
3. Moosabec Bar, Maine.
4. Narraguagus River, Maine.
5. Breakwater from Mount Desert to Porcupine Island, Bar Harbor, Me.
6. Bagaduce River, Maine.
7. Penobscot River, Maine.
8. Belfast Harbor, Maine.
9. Camden Harbor, Maine.
10. Rockland Harbor, Maine.
11. Kennebec River, Maine.
12. Harraseeket River, Maine.
13. Portland Harbor, Maine.
14. Channel in Back Cove, Portland, Me.
15. Saco River, Maine.
16. York Harbor, Maine.
17. Bellamy River, New Hampshire.
18. Cocheco River, New Hampshire.
19. Harbor of refuge at Little Harbor, N. H.

UNITED STATES ENGINEER OFFICE,
Portland, Me., July 3, 1894.

GENERAL: I have the honor to forward annual report for the fiscal year 1894, on harbor and river works in my charge.

Very respectfully, your obedient servant,

PETER C. HAINS,
Lieut. Col., Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

A 1.

IMPROVEMENT OF ST. CROIX RIVER, MAINE.

An examination of the river was made in 1867 by the officer in charge of the district, and subsequently appropriations were made for the improvement amounting to $35,000 in the aggregate, but the appropriation of 1867 provided that the Dominion Government of Canada should expend an equal amount on the improvement. In 1873 the Dominion Government of Canada appropriated $25,000 for improving the river, that being the amount that had been appropriated up to that time by the United States. A conference was held by the engineer of the district with an agent of the Dominion Government, and a plan of improvement was agreed upon. The obstructions consisted of slabs, sawdust, and other mill waste; but before allowing the expenditure of the money appropriated by the Government of Canada the Minister of Public Works required that some guaranty should be given that the further deposit of this refuse in the river should be discontinued. As there did not seem to be any law at that time by which the deposit could be prevented, the money that had been appropriated was not expended on that improvement (with the exception of $1,000 for a survey of the river from the "ledge" to the head of navigation, made in 1873), and in 1879 Congress authorized the appropriations made for the St. Croix to be expended on Lubec Channel, which was done.

The appropriation of 1881 was for "Repairing breakwater on the St. Croix River near, Calais," and was expended for that purpose.

The following appropriations have been made:

Act of—	
March 2, 1867	$15,000
March 3, 1873	10,000
June 23, 1874	10,000
March 3, 1881	4,000
September 19, 1890	35,000
	74,000

The river and harbor act of August 11, 1888, provided for an examination and survey of the St. Croix River, the reports on which were published in Annual Report of the Chief of Engineers for 1890 (p. 463).

When the survey was made the available depth over the shoals at mean low tide was from 6.5 to 9.5 feet, and at the upper steamboat wharf at Calais it was but 1.5 feet. The channel was also narrow.

The improvement proposed was a channel 12 feet deep at mean low tide and generally 200 feet wide (but narrowed to 150 and 100 feet in the upper part of the harbor to avoid ledge) up to the upper steamboat wharf, immediately below the bridge, which marks the head of navigation. Such improvement would enable steamboats to land at the upper wharf at all stages of the tide, and would also permit the larger vessels engaged in the lumber trade to receive their full cargoes at the wharves, instead of dropping down the river nearly 4 miles after being partially loaded and completing their cargoes from material rafted down to them. The object was to be accomplished by dredging and by the construction of a small jetty and training wall. The work proposed extends over about 4 miles of the river. The difference between high and low tides is about 20 feet. The estimated cost of the improvement was $280,000.

The act approved September 19, 1890, appropriated $35,000 for the improvement of the St. Croix, "but upon condition that the Government of the Dominion of Canada shall expend a like sum in the improvement of said river." On account of the proviso contained in the act no expenditures have been made, and no work has been done under the appropriation of September 19, 1890, pending action by the Dominion Government.

Money statement.

July 1, 1893, balance unexpended	$35,000.00
July 1, 1894, balance unexpended	35,000.00
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	245,000.00

COMMERCIAL STATISTICS.

Receipts and Shipments.

Articles.	1891.	1892.	1893.
	Tons.	*Tons.*	*Tons.*
Bricks	500	1,000	500
Cement	1,000	800	700
Coal	30,000	35,000	40,000
Cotton	5,730	6,000	6,000
Farm produce	10,000	10,000	8,000
Grain	10,000	12,000	10,000
Flour	8,000	8,000	10,000
Iron	1,000	1,500	2,000
Lime	5,000	4,000	3,000
Lumber	190,000	180,000	170,000
Plaster	15,000	16,000	15,000
Plaster rock	17,000	17,000	20,000
Granite	....	....	2,000
Miscellaneous	100,000	100,000	75,000
Total	393,230	391,300	362,200

Number of vessels arriving and departing during calendar year 1893.

Vessels 150 tons and upward	750
Sloops and lighters 100 tons and under	600
Steamers and foreign cargoes	700

A 2.

IMPROVEMENT OF LUBEC CHANNEL, MAINE.

This channel lies between the eastern extremity of the State of Maine and Campobello Island, Dominion of Canada. It has a length of between 2 and 3 miles, connecting the waters of Quoddy Roads below with those of Friar Roads above. The least width between low-water contours is about 400 feet, and between high-water contours about 800 feet. The mean range of tides is about 17 feet. It affords a sheltered route, and the most direct one, for vessels to and from Eastport and the St. Croix River, besides being the only passage not in waters belonging to the Province of New Brunswick. The channel is also important in connection with Quoddy Roads as a harbor of refuge. During such storms as make anchorage in the latter unsafe, vessels may escape through the Lubec Channel into sheltered waters above.

The following appropriations have been made:

Act of—	
March 3, 1879	$44,000
June 14, 1880	20,000
March 3, 1881	45,000
August 2, 1882	20,000
July 5, 1884	10,000
August 5, 1886	10,000
August 11, 1888	20,000
Total	169,000

Previous to 1879 the mean low-water depth in the channel did not exceed 5 feet, and at extreme low water the depth did not exceed 2 feet.

The project adopted in 1879 provided for a channel 200 feet wide and 12 feet deep at mean low tide, which would be equivalent to 9 feet at low spring tides. The estimated cost was $48,000.

This estimate was based on prices below what the work was subsequently done for. This project was revised in 1880, the estimated cost being increased to $130,000. The project was again, in 1884, amended so as to provide a channel 275 feet wide and 300 feet wide in the bends, the depth of 12 feet being retained, and the estimated cost of the entire project being increased to $171,500.

At the close of the fiscal year ending June 30, 1893, there had been expended the sum of $168,954.42. The project was completed.

The river and harbor act approved September 19, 1890, contained an order for an examination of Lubec Channel, the report on which was published in the Annual Report of the Chief of Engineers for 1891 (p. 616). A new project is therein submitted for a channel having a least width of 500 feet and a depth of 12 feet at mean low water, the cost, in addition to the amount already expended, being estimated at $231,000.

No work was done during the year ending June 30, 1894. The expenditures were 26 cents, making the total expenditures to that date $168,954.68.

There is a light-house on Campobello Island at the narrows, opposite Lubec. Lubec is in the collection district of Passamaquoddy.

Money statement.

July 1, 1893, balance unexpended	$45.58
June 30, 1894, amount expended during fiscal year	.26
July 1, 1894, balance unexpended	45.32

COMMERCIAL STATISTICS.

The commerce of Lubec Channel not being local in its character, it is impracticable to obtain statements of the tonnage. During the year ending March 31, 1894, the keeper of the Lubec Channel Light Station observed 3,221 vessels passing the station, of which 2,487 were sail and 734 were steam.

A 3.

IMPROVEMENT OF MOOSABEC BAR, MAINE.

Moosabec Bar is in the eastern part of Moosabec Reach, near Jonesport, Maine. At mean low stages the depth was less than 6 feet and at extreme low tides the depth was less than 4 feet. In fogs, which are prevalent on this part of the coast, navigation was rendered dangerous by the tortuous route that had to be taken to keep clear of the ledges.

A survey, ordered in the river and harbor act of March 3, 1879, was made by Col. George Thom and a project of improvement suggested, the estimated cost of which was $28,000. The project contemplated the excavation of a straight channel, running nearly east and west, 200 feet wide and 14 feet deep at mean low tide, and the removal of a sunken ledge near Steamboat Buoy to 15 feet. The project was adopted in 1881, but the estimated cost was increased to $35,000. In 1882 the project was amended, as it was found that the quantity of dredging had to be increased, so that the cost as revised was estimated at $40,000. Work on that project was continued until 1888, when it was amended so as to provide for a channel 300 feet wide and 14 feet deep, the removal of certain ledges near the westerly end of the dredged channel to a depth of 16 feet, and the construction of a small breakwater to check cross currents. The estimated cost of the additional work was $110,000, and that for the entire improvement as enlarged $150,000. This latter project is the one now in process of execution.

The following appropriations have been made:

Act of—	
March 3, 1881	$10,000
August 2, 1882	10,000
July 5, 1884	10,000
August 5, 1886	10,000
August 11, 1888	15,000
September 19, 1890	15,000
July 13, 1892	15,000
Total	85,000

The expenditures to June 30, 1893, were $60,793.65.

At the latter date the 300-foot channel had been completed to the full projected width and depth, the breakwater had been built, and a small quantity of ledge had been removed.

The expenditures during the past year amounted to $14,638.36.

The operations consisted in excavation of ledge obstructing the western approach to the dredged channel; 1,047 cubic yards of ledge were removed, making a depth of 16 feet at mean low tide. The price was $13.35 per cubic yard, measured in place.

Another contract was made March 22, 1894, for continuing the removal of ledge in the western approach to the channel, at $13.25 per cubic yard, measured in place. It is expected to remove, under this contract, about 800 yards, the contract to be completed during the present season. The work was commenced in May, 1894, and was in progress at the close of the fiscal year.

The improvement is in the collection district of Machias, Me. The nearest light house is Moose Peak. The nearest port of entry is Machias, Me.

Money statement.

July 1, 1893, balance unexpended		$24,206.35
June 30, 1894, amount expended during fiscal year		14,638.36
July 1, 1894, balance unexpended		9,567.99
July 1, 1894, outstanding liabilities	$300.00	
July 1, 1894, amount covered by uncompleted contracts	9,000.00	
		9,300.00
July 1, 1894, balance available		267.99
Amount (estimated) required for completion of existing project		65,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896		25,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

Abstract of proposals for removal of ledge in western approach to channel through Moosabec Bar, Maine. March 5, 1894.

No.	Name and address of bidder.	795 cubic yards ledge.	
		Price per cubic yard.	Amount.
1.	Townsend & Johnston, Somers Point, N. J.	$13.25	$10,533.75
2.	Townsend & Sturgis, Boston, Mass.	15.43	12,266.85

Contract made with Townsend & Johnston, March 22, 1894.

Abstract of contracts for improving Moosabec Bar, Maine, in force during the fiscal year ending June 30, 1894.

No.	Name and address of contractor.	Date of contract.	Subject of contract.	Price.
*1.	Johnston & Townsend, Somers Point, N. J.	Dec. 23, 1892	Removal of ledge in western approach to channel.	†$13.35
2.	Townsend & Johnston, Somers Point, N. J.	Mar. 22, 1894	Removal of ledge in western approach to channel.	†13.25

* Contract completed. † Per cubic yard in place.

The benefits derived from the improvement are not local, the thoroughfare being used by coastwise vessels both as a harbor of refuge and as a sheltered route in bad weather. It is therefore impracticable to obtain accurate commercial statistics. The number of vessels passing through the reach annually has been estimated to be as great as 2,500.

A 4.

IMPROVEMENT OF NARRAGUAGUS RIVER, MAINE.

The part of the river to which the project of improvement applies is that near the mouth and at the head of Narraguagus Bay, below the village of Millbridge. The river is navigable for small vessels as far up as Cherryfield, 5 miles above Millbridge.

Before the improvement was commenced the depth over the bar at the mouth of the river was less than 6 feet at mean low tide and less than 4 feet at extreme low tide.

From Millbridge to Cherryfield, the head of navigation, a distance of about 5 miles, the navigation was obstructed by bowlders and ledges.

The following appropriations have been made:

For improvement above Millbridge:	
Act of March 3, 1871	$12,000
Act of June 10, 1872	10,000
For improvement of river from its mouth to Millbridge:	
Act of August 5, 1886	10,000
Act of August 11, 1888	10,000
Act of September 19, 1890	7,500
Act of July 13, 1892	7,500
Total	57,000

The original project provided only for the betterment of navigation above Millbridge by the removal of obstructions, such as mill waste, sunken bowlders, and projecting ledges, and the construction of an iron spindle on Half Tide Rock. This work was completed in 1874, the amount expended being $22,000 (the first two appropriations). The resulting improvement is said to have been of great benefit to navigation.

A second project for the improvement of the river below Millbridge was submitted in 1880, but no appropriation was made until 1886.

The project for the improvement of this part of the river has for its object the dredging of a channel not less than 200 feet wide from deep water in Narraguagus Bay to the place known as "Deep Hole," where vessels anchor in bad weather, the depth to be 11 feet at mean low water as far up as Long Point, and from thence to "Deep Hole" to be 9 feet.

The mean range of the tides is 11.2 feet.

The estimated cost of this improvement was $50,000.

The expenditures under the last project, up to June 30, 1893, amounted to $27,543.72. At that date there had been dredged an 11-foot channel from the deep water in the bay in toward the new steamboat wharf 90 feet wide, with a space in front of the wharf 300 feet wide. From the new steamboat wharf to the old one near Long Point the channel was 100 feet wide, with a turning basin in front of the old wharf 300 feet wide.

The expenditures during the fiscal year ending June 30, 1894, amounted to $15.68. No work was in progress during the year. Proposals for dredging were opened October 3, 1892, and again November 16, 1892, but each time all bids were rejected, the prices being high. The work will be again advertised.

The improvement is in the collection district of Machias. The nearest port of entry is Machias. The nearest light-house is Narraguagus Light-House, on Pond Island.

Money statement.

July 1, 1893, balance unexpended	$7,456.28
June 30, 1894, amount expended during fiscal year	15.68
July 1, 1894, balance unexpended	7,440.60
Amount (estimated) required for completion of existing project	15,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	15,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

COMMERCIAL STATISTICS.

Receipts and shipments.

Articles.	1891.	1892.	1893.
	Tons.	*Tons.*	*Tons.*
Coal	1,200	2,000	1,500
Fish and salt	1,582		400
Hides and leather	675		800
Hay		300	75
Hardware and iron	200	1,500	2,000
Lumber	38,077	30,000	50,000
Miscellaneous	4,725	7,000	2,600
Stone and silica	2,500	4,500	3,500
Total	48,959	45,300	60,875

There arrived during the calendar year 1893, steamers, coastwise, average draft, 7 feet; tonnage, 300,000. Sailing vessels, coastwise, average draft, 9 feet; tonnage, 30,000. Vessels for refuge only, tonnage, 15,000.

A 5.

BREAKWATER FROM MOUNT DESERT TO PORCUPINE ISLAND, BAR HARBOR, MAINE.

The anchorage in front of the town of Bar Harbor, Mount Desert Island, Maine, as well as the wharves at which steamers make their landings, is exposed to the seas from southerly and southeasterly directions. In southerly gales the anchorage is insecure, and the landing of passengers and freight at the wharves is difficult at such times. The number of people that visit Bar Harbor in the summer is large, but the amount of freight delivered and shipped is comparatively small. The anchorage is used chiefly by yachts. There are neither factories nor quarries on this part of the island, and the trade is chiefly in supplies of all kinds for summer visitors.

The original project was the construction of a riprap breakwater from the westerly side of Round Porcupine Island to Dry Ledge and thence in a direct line to a point near the shore of Mount Desert Island. In December, 1890, it was proposed to slightly change the direction of the part of the breakwater west of Dry Ledge, so that the westerly end would be somewhat farther to the southward.

In January, 1893, the project was again amended and now provides for the construction of a breakwater on the direct line first proposed, but somewhat shorter, terminating at a distance of about 600 feet from the low-water line on Mount Desert Island, the structure to be built to the level of mean high tide, with slopes of 1 on 1, and a width of 20 feet on top throughout its entire length. This construction will, it is believed, answer all needful requirements at this locality and at a total cost not much more than one-half that of the project of 1890.

The estimated cost of the project as it now stands is $420,200.

The following appropriations have been made:

Act of—	
August 11, 1888	$50,000
September 19, 1890	50,000
July 13, 1892	50,000

The expenditures to June 30, 1893, amounted to $53,535.92. Up to the latter date the entire quantity of stone placed in the work amounted to 52,089 tons. That part of the breakwater between Porcupine Island and Dry Ledge was completed, and 9,921 tons of stone had been deposited in the work west of Dry Ledge.

The expenditures during the past fiscal year were $47,534.60, making the total expenditures $101,070.52.

At the close of the fiscal year 1893 work was in progress, under contract, on that part of the breakwater west of Dry Ledge. The contract was completed early in October, 1893, the entire quantity of stone delivered under the contract being 49,258 tons; the breakwater west of Dry Ledge was at that time completed to full section for a distance of 325 feet.

November 22, 1893, a contract for continuing the construction of the breakwater was made with William S. White, of Rockland, Me., at 97 cents per ton, about 50,000 tons of stone to be deposited. The contractor commenced late in April, 1894, and at the close of the fiscal year about one-half the amount of stone covered by the contract had been deposited in place.

Bar Harbor is in the collection district of Frenchman Bay. The nearest port of entry is Ellsworth. The nearest light-house is on Egg Rock, 3¼ miles distant.

Money statement.

July 1, 1893, balance unexpended		$96,464.08
June 30, 1894, amount expended during fiscal year		47,534.60
July 1, 1894, balance unexpended		48,929.48
July 1, 1894, outstanding liabilities	$24,450.00	
July 1, 1894, amount covered by uncompleted contracts	24,250.00	
		48,700.00
July 1, 1894, balance available		229.48
Amount (estimated) required for completion of existing project		270,200.00
Amount that can be profitably expended in fiscal year ending June 30, 1896		50,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

Abstract of proposals for construction of breakwater from Mount Desert to Porcupine Island, Maine, October 31, 1893.

No.	Name and address of bidder.	From Porcupine Ledge in a westerly direction (50,000 tons of stone).	
		Price per ton.	Amount.
1	Townsend & Johnston, Somers Point, N. J	$1.20	$60,000
2	Perkins & White, Boston, Mass	.97	48,500
3	Thomas A. Rowe, Boston, Mass	1.03	51,500
4	James & Geyer, Chelsea, Mass	.97½	48,750
5	William S. White, Rockland, Me	.97	48,500

Contract made with William S. White, November 22, 1893.

Abstract of contracts for construction of breakwater from Mount Desert to Porcupine Island, Maine, in force during fiscal year ending June 30, 1894.

No.	Name and address of contractor.	Date of contract.	Subject of contract.	Price for stone per ton.
*1	William S. White, Rockland, Me.	June 1, 1892.	Breakwater west of Dry Ledge	$1.02
2	William S. White, Rockland, Me.	Nov. 22, 1892.	Breakwater west of Porcupine Ledge.	.97

* Contract completed.

COMMERCIAL STATISTICS.

It was impracticable to obtain a definite statement in tons of articles. The following letter has been received:

FEBRUARY 27, 1894.

SIR: In answer to your letter I inclose a list of steamers that arrived at Bar Harbor during the season from March to November. There are many tons that arrived there in the shape of yachts and steamers that came down for a season, but can not give you figures on that. The list is what we call the regular line for business.

Respectfully,

JOHN D. HOPKINS,
Collector.

Lieut. Col. PETER C. HAINS.

Arrivals and departures.

Steamers.	Gross tons.	Net tons.	Trips.
Sappho	275.55	137.78	5 daily.
Sebenoa	89.12	44.56	2 daily.
Silver Star	75.50	42.95	5 daily.
Golden Rod	71.16	52.57	2 daily.
Mount Desert	457.16	283.85	1 daily.
Frank Jones	1,634.42	1,078.65	2 per week.
Sedgwick	155.52	84.28	3 per week.
Cimbria	289.14	247.42	3 per week.
Winthrop	1,442.87	1,019.34	1 per week.
Creedmore	19.43	11.11	
Sorrento	49.36	24.68	

A 6.

IMPROVEMENT OF BAGADUCE RIVER, MAINE.

The Bagaduce is a small stream that empties into Penobscot Bay at Castine, Me. The upper part of the river divides into two branches, one called Northern Bay and the other South Bay.

Northern Bay, near South Penobscot, is a shoal sheet of water of about 700 acres area, the bottom of which for the greater part is bare at low tide. There is a narrow channel from Bridges Point to Bowdens Wharf, which had a depth of less than 2 feet and is obstructed by ledges near Winslows Island. The South Bay is obstructed by ledges at Johnsons Narrows.

A project for the improvement of the Northern Bay was adopted in 1890, which has for its object the securing of a channel 100 feet wide and 6 feet deep at mean low tide from Bridges Point to Bowdens Wharf, at an estimated cost of $45,000.

It is also intended to remove a small quantity of rock obstructing the South Bay at Johnsons Narrows, at an estimated cost of $1,875.

The mean range of tides is about 9.5 feet.

The following appropriations have been made:

Act of—	
August 11, 1888	$3,000
September 19, 1890	4,000
July 13, 1892	5,000

The expenditures to the close of the fiscal year ending June 30, 1893, amounted to $219.72. No work had been done.

The expenditures during the year ending June 30, 1894, were $11,780.28, making the total expenditures $12,000.

During July, 1893, under contract with Edgar P. Lovering, of Boston, Mass., the work of dredging the channel was commenced, and was continued until the 21st of the following November, when the funds were exhausted. Under this contract 30,052 cubic yards of material were dredged, and 506½ tons of large bowlders removed. The contract prices were 25 cents per cubic yard for the dredging, and $3 per ton for removing the bowlders. The channel was dredged its entire length for a width of 40 feet, but the full projected depth was not obtained throughout. There is now an available depth of about 2 feet more than before the improvement was commenced.

The improvement is in the collection district of Castine. The nearest port of entry is Castine, at the mouth of the river. The nearest light-house is at Dice Head.

Money statement.

July 1, 1893, balance unexpended	$11, 780. 28
June 30, 1894, amount expended during fiscal year	11, 780. 28
Amount (estimated) required for completion of existing project	34, 875. 00
Amount that can be profitably expended in fiscal year ending June 30, 1896	25, 000. 00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

COMMERCIAL STATISTICS.

Receipts and Shipments.

Articles.	1891.	1892.	1893.
	Tons.	*Tons.*	*Tons.*
Bricks	6, 000	7, 500	8, 000
Coal	2, 200	2, 350	2, 300
Cotton	150	150	200
Farm produce	250	300	400
Fish	150	300	250
Grain	8, 000	9, 000	9, 000
General merchandise	15, 300	17, 000	18, 000
Ice	150	200	250
Lumber	2, 800	3, 500	5, 000
Lime, cement, etc	300	400	400
Wood	6, 000	5, 400	5, 500
Total	41, 300	46, 100	49, 300

Most of the above is landed and shipped from Castine, at the mouth of the river.

A 7.

IMPROVEMENT OF PENOBSCOT RIVER, MAINE.

A survey of the Penobscot River was made in 1867 under the provisions of the act of Congress approved June 23, 1866. The navigation at that time was obstructed by rocks, ledges, and mill waste, giving at mean low tide only about 8 feet of water and a narrow, tortuous, and uncertain channel. At Bangor the depth was only about 6 feet at lowest stages, while numerous rocks and ledges made navigation dangerous. Colonel Thom, under whose direction the survey was made, submitted an estimate for two projects of improvement, one giving a channel 150 feet wide and 12 feet deep at extreme low tide, up as far as Bangor, at an estimated cost of $125,000, and another with a depth of 18 feet at extreme low tide, at an estimated cost of $665,000.

The improvement of navigation was not undertaken, however, until 1870, when the first appropriation was made. Work on the 12-foot project was then systematically undertaken and was continued until 1880, under the several appropriations made by Congress. The original project was amended several times during this period. This was rendered necessary by the discovery of shoals where before they were not known to exist, and by work being ordered by Congress which was not included in the original estimates. In 1876 the project was amended so as to provide for a depth of 11 feet at extreme low tide, and as thus amended it was completed in 1880. The expenditures up to that time amounted to $198,000, and had resulted in straightening, deepening, and widening the channel through the several shoals and bars at Bangor and for a distance of about 3½ miles downstream, giving it a width of 200 feet and a depth of not less than 11 feet at extreme low tide, or 14 feet at mean low stages; also in breaking up and removing all the sunken ledges and bowlders in the harbor of Bangor, some outside the main channel, down to the level of the general bed of the river, including Independence Rock, Gulliver's Rock, ledge near the steamboat wharf, and those near Dole's Wharf, Green's Pier Ledge, and a ledge outside of it, the ledges and bowlders in front of the wharves at High Head, and also the removal of the shoal at Bucksport, known as the Middle Ground, on which there had formerly been only 4 feet of water at mean low tide.

No further work was done on the Penobscot River until 1883, when a new survey was made by Col. Blunt, under the provisions of the river and harbor act of 1882. He reported that the improvements made were satisfactory, as far as they went, but the increasing commerce of Bangor demanded additional facilities. He submitted a project for widening the channel at Bangor 100 feet, making it 300 feet wide, and for widening, straightening, and deepening the river near Crosbys Narrows, at an estimated cost of $75,000. A project for this improvement was adopted in 1884 and work on it begun. While it was in progress the river and harbor act of 1886 called for another survey of the Penobscot River from Bangor to Bucksport Narrows. This survey was made in 1887, under the direction of Lieut. Col. Jared A. Smith, who submitted a project January 11, 1888, for improving the river from Winterport to Bucksport, at an estimated cost of $365,000. The project contemplated the securing of 22 feet at mean low tide between Bucksport and Winterport, by means of contraction works aided by dredging. The estimated cost of the two projects combined was thus made $440,000, of which $85,000 had already, in 1888, been appropriated. The act of September 19, 1890, appropriated $25,000 and provided for dredging near Sterns Mill. This was no part of any of the projects submitted, but was ordered by Congress.

In the river and harbor act of September 19, 1890, Congress directed still another survey to be made of the Penobscot River, Maine. This was done by Lieut. Col. Jared A. Smith, Corps of Engineers, and a report was submitted which was published as House Ex. Doc. No. 37, Fifty-second Congress, first session. The works of improvement suggested in this report are to still further widen the channel at Bangor on the Brewer side 60 feet, making it 360 feet wide, keeping the same depth as before; to deepen the river between Winterport and Bucksport by the construction of jetties, to 22 feet at mean low tide, and near Crosbys Narrows to 12 feet by the same means. The estimated cost of this last project is $202,000.

The general project under which the improvement of the Penobscot River is now being carried on may be stated as follows:

To widen the channel at Bangor to 360 feet and a depth of 11 feet at extreme low tide; to widen, straighten, and deepen the channel near Crosbys Narrows and near Sterns Mill to a depth of 12 feet at extreme low tide; and to secure a channel depth of 22 feet at mean low tide between Bucksport and Winterport, the estimated cost of the entire work being $440,000, of which $150,000 has been already appropriated.

This estimate includes the cost of jetties at Frankfort Flats and High Head to contract the waterway, should contraction be necessary. It is thought, however, that as the deposit of sawdust and mill waste into the river has, in a large measure, been stopped, and as the channels at these places were obstructed chiefly by this material, the contraction works may not be necessary. The channel at Frankfort Flats was dredged in 1890 to 22 feet. Subsequently it filled up on the sides to some extent, the full depth in mid channel being maintained. A recent survey shows that it has scoured out again, and there now exists a navigable channel not less than 500 feet wide and 22 feet or more in depth at low tide. As this is all the project aims at, no further works of any kind are needed at Frankfort Flats.

The channel at High Head, which had deepened in 1891 from natural causes, subsequently filled up to some extent, so that it became advisable to dredge a channel the full depth and width called for by the project. A recent survey shows that it has deepened again so that there is an available depth of 22 feet at low tide, though the channel is not as wide as it should be.

If the dredging now in progress at High Head gives as good results as that at Frankfort Flats has done, and there is every reason to believe that it will, no further work on this section of the river will be necessary. Under any circumstances it is believed that any filling that may take place in the future will be but temporary. A slight spring freshet will clear it, as it has done at Frankfort Flats.

The construction of jetties at Frankfort Flats and High Head should be avoided if practicable on account of their great cost.

Under the circumstances, no appropriation is asked for the Penobscot River.

The following appropriations have been made for the Penobscot River:

March 2, 1829 (for survey)	$300
July 11, 1870 (at Bangor and below	15,000
March 3, 1871 (at Bangor and below)	50,000
June 10, 1872	40,000
March 3, 1873	20,000
June 23, 1874	20,000
March 3, 1875 ($10,000 to be expended at or near Bucksport Narrows)	25,000
August 14, 1876 ($4,000 to be expended at or near Bucksport Narrows)	10,000
June 18, 1878 ($2,500, or so much thereof as necessary, to be expended at or near Bucksport Narrows)	12,000
March 3, 1879	6,000
July 5, 1884 (for Bangor Harbor and Penobscot River)	20,000
August 5, 1886 (for widening channel at Bangor and removing obstructions near Crosbys Narrows)	15,000
August 11, 1888 ($20,000 to be expended between Bangor and Crosbys Narrows, and $30,000 between Bucksport and Winterport)	50,000
September 19, 1890 (for continuing improvement and for dredging near Sterns Mill)	25,000
July 13, 1892	40,000
Total	348,300

The expenditures under the various projects up to the close of the fiscal year ending June 30, 1893, amounted to $302,510.45.

The results accomplished were the widening and deepening of the channel at Bangor from a depth of 6 feet at extreme low tide to 11 feet, for a width of 300 feet; the dredging of the shoal at Sterns Mill to 12 feet and of the shoal just below Sterns Mill to the same depth; the removal of rocks, ledges, and other obstructions; the dredging of the shoal near Bucksport, and a general increase in depth and width of channels from the mouth up to Bangor.

The expenditures during the last fiscal year were $16,754.32, making the total expenditures for the work $319,264.77.

At the date of the last annual report the work of widening, by dredging, the channel at Bangor to 360 feet had been commenced under a contract with Martin V. B. Mower. The contract was completed late in November, 1893. The total quantity of material dredged was 43,780 cubic yards, scow measurement.

It was found that some shoaling had taken place in the channel at Bangor, and on March 5, 1894, proposals were opened for dredging about 15,000 cubic yards at Bangor and about 75,000 cubic yards at High Head, just above Bucksport, making the full projected depth of 22 feet at mean low tide at the latter place. The bids were considered high and were all rejected, and the work readvertised. Proposals were again opened April 21, 1894, and a contract was made under date of May 9, 1894, with Lynn Dredging Company, of Lynn, Mass., at 36 cents per cubic yard for the work at Bangor and 15½ cents per cubic yard for that at High Head. The work was commenced about the 1st of June and was in progress at the close of the year.

Bangor, at the head of navigation, is a port of entry.

Money statement.

July 1, 1893, balance unexpended		$45, 789. 55
June 30, 1894, amount expended during fiscal year		16, 754. 32
July 1, 1894, balance unexpended		29, 035. 23
July 1, 1894, outstanding liabilities	$500. 00	
July 1, 1894, amount covered by uncompleted contracts	17, 025. 00	
		17, 525. 00
July 1, 1894, balance available		11, 510. 23
Amount (estimated) required for completion of existing project		290, 000. 00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

Abstract of proposals for dredging in Penobscot River, Maine, March 5, 1894.

No.	Name and address of bidder.	Bangor Harbor (15,000 cubic yards).		High Head (75,000 cubic yards.)		Total.
		Price per cu. yard.	Amount.	Price per cu. yard.	Amount.	
		Cents.		*Cents.*		
1	Lynn Dredging Company, Lynn, Mass	38	$5, 700	17½	$13, 125	$18, 825
2	Charles H. Souther, Boston, Mass	40$\frac{7}{10}$	6, 000	19	14, 250	20, 250
3	Moore & Wright, Portland, Me	42	6, 300	18	13, 500	19, 800
4	Charles W. Anthony, Fall River, Mass	40	6, 105	19. 1	14, 325	20, 430
5	Augustus B. Martin, Boston, Mass	45	6, 750	20	15, 000	21, 750

All bids rejected as being too high.

Abstract of proposals for dredging in Penobscot River, Maine, April 21, 1894.

No.	Name and address of bidder.	Bangor Harbor (15,000 cubic yards).		High Head (75,000 cubic yards).		Total.
		Price per cu. yard.	Amount.	Price per cu. yard.	Amount.	
		Cents.		*Cents.*		
1	Charles W. Anthony, Fall River, Mass	38$\frac{7}{10}$	$5, 805	17$\frac{3}{10}$	$12, 975	$18, 780
2	Lynn Dredging Company, Lynn, Mass	36	5, 400	15½	11, 625	17, 025

Contract made with Lynn Dredging Company May 9, 1894.

Abstract of contracts for improving Penobscot River, Maine, in force during fiscal year ending June 30, 1894.

No.	Name and address of contractor.	Date of contract.	Subject of contract.	Price per cu. yard.
				Cents.
*1	Martin V. B. Mower, Lynn, Mass.	Feb. 2, 1893.	Dredging channel	32
2	Lynn Dredging Company, Lynn, Mass.	May 9, 1894.	Dredging channel in Bangor Harbor.	36
			Dredging channel at High Head, above Bucksport.	15¼

* Contract completed.

COMMERCIAL STATISTICS.

Receipts and shipments.

Articles.	1891.	1892.	1893.
	Tons.	*Tons.*	*Tons.*
Ashes	500	500	575
Bricks	8, 575	3, 266	2, 840
Brimstone	....	500	535
Coal	104, 113	115, 000	120, 000
Farm produce	2, 025	2, 000	2, 300
Fish and oysters	107	200	240
Flour and grain	11, 865	6, 325	6, 840
Fertilizer and plaster rock	1, 400	2, 000	2, 140
General merchandise	51, 333	52, 209	53, 420
Hay and wood	72, 220	12, 647	13, 000
Iron, castings, etc	505	840	12, 600
Ice	270, 000	181, 000	90, 000
Lime and cement	568	4, 350	4, 400
Lumber	320, 000	294, 603	223, 332
Last blocks	....	400	400
Molding sand and potters' clay	....	1, 000	1. 200
Miscellaneous	53, 728	....	700
Molasses and salt	1, 841	2, 701	1, 771
Oil	2, 500	3, 094	3, 594
Paving stone, granite, and slate	30, 500	32, 300	26, 000
Total	931, 780	714, 935	565, 887

Number of vessels arriving in calendar year 1893.

Vessels.	Number.	Tonnage.
Steamers, coastwise, drawing 10 feet or more	720	259, 200
Steamers, coastwise, drawing less than 10 feet	530	79, 650
Sailing vessels, foreign, drawing 10 feet or more	13	8, 425
Sailing vessels, coastwise, drawing 10 feet or more	788	237, 976
Sailing vessels, coastwise, drawing less than 10 feet	954	95, 400
Barges, drawing 10 feet or more	31	9, 300

A 8.

IMPROVEMENT OF BELFAST HARBOR, MAINE.

Before the improvement was begun the harbor was not deep enough to accommodate the steamers and other vessels that visited the port.

Near Lane's Wharf there was a shoal on which the depth was only about 4 feet at mean low tide, but it deepened toward the mouth of the harbor.

A survey was made of the harbor in 1875 and a report submitted. As a result of the survey it was ascertained that to so improve the harbor as to afford a safe anchorage for shipping in all storms, and have a suitable depth for the several steamers and other vessels that touch and lie there in all stages of the tide, would require the removal of certain shoals and the construction of a breakwater or breakwaters at the entrance to the harbor. The estimated cost was $347,000. The dredging alone was estimated to cost $35,000. The latter was, in 1876, the project adopted. The construction of the breakwaters was abandoned.

The project contemplated dredging the lower part of the shoal to 12 feet at low tide between the channel and the wharf line as far up as the wharf of the Boston and Bangor line of steamers, and from thence between the channel and the wharf line up to near Lane's Wharf to 10 feet at low tide. That project was completed in 1879, at a cost of $22,000.

A new survey or examination of the harbor was ordered in the river and harbor act of August 11, 1888. This was made, and a new project adopted in 1890. The new project proposes to dredge a channel from the deep water at the entrance, to the upper harbor 250 to 300 feet wide and 15 feet deep at mean low tide; to dredge an area 8 feet deep on the north side of the harbor, so that vessels of that draft can reach the wharf in front of Pierce's ice house and mills at low tide; to dredge an area on the south side of the channel to a depth of 13 feet at mean low tide, to accommodate vessels touching at the Boston and Bangor Steamboat Company's Wharf. The estimated cost of the new project is $52,000.

The following appropriations have been made:

Act of—	
August 14, 1876	$5,000
June 18, 1878	12,000
March 3, 1879	5,000
June 14, 1880	3,000
September 19, 1890	10,000
July 13, 1892	10,000
Total	45,000

The total expenditures on Belfast Harbor up to June 30, 1893, were $35,026.05. At that date the 8-foot dredging near Pierce's Wharf had been completed, and dredging at the channel of entrance was in progress under a contract with Hamilton & Sawyer.

The expenditures during the last fiscal year were $9,973.95, making the total expenditures for this improvement $45,000. By the middle of July, 1894, the dredging at the entrance was brought to a close, 40,040 cubic yards of material in all having been dredged, which was all that the funds would allow, making the full depth of 15 feet at mean low tide for a width of from 125 to 225 feet.

Belfast is in the collection district of Belfast. The nearest light-house is Dice Head, near Castine.

Money statement.

July 1, 1893, balance unexpended	$9,973.95
June 30, 1894, amount expended during fiscal year	9,973.95
Amount (estimated) required for completion of existing project	32,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	32,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

COMMERCIAL STATISTICS.

Receipts and shipments.

Articles.	1891.	1892.	1893.
	Tons.	*Tons.*	*Tons.*
Coal	10, 710	10, 800	10, 900
Farm produce	910	915	820
Fertilize	1, 500	3, 000	3, 000
Grain	5, 029	5, 000	5, 300
Hay	7, 127	7, 450	3, 600
General merchandise	20, 112	21, 200	20, 200
Lumber	3, 400	2, 900	2, 500
Ice	13, 000	8, 000	5, 000
Lime	1, 325	1, 410	1, 200
Stone	7, 000	6, 000	5, 200
Wood	980	850	750
Total	71, 093	67, 525	58, 470

A 9.

IMPROVEMENT OF HARBOR AT CAMDEN, MAINE.

A survey was made of Camden Harbor in 1872 with a view to the improvement of its navigation, which prior to that time had been obstructed by the shoalness of the water over nearly all of its area, there being less than 12 inches depth over the most of it.

The first project was for regulating the entrance by dredging between the two principal steamboat wharves, which were located on opposite sides of the entrance; dredging a channel about 1,500 feet long, 100 feet wide, and 7 feet deep at mean low tide from the entrance up to the head of the wharves on the easterly side of the harbor, and a channel 1,400 feet long, of the same width and depth, extending up to the head of the wharves on the westerly side of the harbor. The total excavation required was about 90,000 cubic yards and the estimated cost $33,000. The total amount actually expended on the project was $30,000, and with the expenditure of this amount the project was completed in 1876.

In the harbor and river act of 1886 a new survey of Camden Harbor was ordered. This was made in 1887, and a project submitted for further improvement of the harbor. The dredged channels which had been made under prior appropriations, though they had not filled up to any appreciable extent, were not deep and wide enough to accommodate the increasing commerce. The new project contemplates: (1) The dredging of an area at the entrance to the harbor, and near the Boston Steamboat Wharf, to a depth of 12 feet at mean low tide; (2) the dredging of an area at the entrance, so as to afford more easy access to the harbor, to a depth of 10 feet at mean low tide; (3) the dredging of a channel along the wharf line on the west side of the harbor as far up as Alden's Wharf to a depth of 10 feet, and from thence up to the anchor factory and to Derow's shipyard to a depth of 5 feet at mean low tide; (4) the dredging of a channel on the east side nearly up to Gilkey's Wharf to a depth of 10 feet, and from thence up to Dailey's shipyard to a depth of 5 feet at mean low tide. These channels are to be about 50 feet wide at the upper end, where the depth is to be 5 feet, and about 100 feet wide where the depth is to be 10 feet.

The removal of the middle ground—that is, the space between the two channels—though desirable, was not regarded as an essential part of the project, and was not to be undertaken until the other parts had been completed. Subsequently its removal was included in the project.

The estimated cost of the entire work was $60,000.

The following appropriations have been made:

Act of—	
March 3, 1873	$10,000
June 23, 1874	10,000
March 3, 1875	10,000
August 11, 1888	5,000
September 19, 1890	6,000
July 13, 1892	12,000
Total	53,000

The expenditure of the first three appropriations resulted in giving a good entrance to the harbor, and two channels, one on each side along the lines of wharves, not less than 6 feet deep at mean low tide.

The total expenditures up to the close of the fiscal year ending June 30, 1893, inclusive of both projects, amounted to $41,041.93. As a result the western channel had been dredged to a depth of 10 feet at mean low tide throughout its entire length, including the approach, the latter to a width of 125 feet and the channel itself to a width of 100 feet.

The expenditures during the last fiscal year were $11,934.28. Dredging, under contract with Hamilton & Sawyer, was commenced July 21 and continued until October 16, 1893. The total amount dredged was 42,000 cubic yards, completing the work of dredging the channel of entrance, and the area near the Boston Steamboat Wharf, and about 400 feet of the 10-foot channel on the eastern side of the harbor. After completion of the dredging, 11 large bowlders which obstructed the entrance were removed by hired labor, at an expense of about $550.

Camden is in the collection district of Belfast. The nearest light-house is on Negro Island, at entrance to harbor.

Money statement.

July 1, 1893, balance unexpended	$11,958.07
June 30, 1894, amount expended during fiscal year	11,934.28
July 1, 1894, balance unexpended	23.79
July 1, 1894, outstanding liabilities	10.00
July 1, 1894, balance available	13.79
Amount (estimated) required for completion of existing project	37,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	37,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

COMMERCIAL STATISTICS.

The receipts and shipments for the calendar year 1891 were reported as 45,575 tons. It has been impracticable to obtain statistics for the year 1893, but it is thought the tonnage did not materially differ from that reported for 1891.

A 10.

IMPROVEMENT OF HARBOR AT ROCKLAND, MAINE.

The location of Rockland Harbor is such that, besides accommodating its own commerce, it affords a convenient refuge for large numbers of coasting vessels. When the project for a breakwater was adopted the harbor was open to easterly storms, the anchorage was unsafe, and the seas often broke over the wharves.

The following appropriations have been made for the improvement of Rockland Harbor:

Act of—	
June 14, 1880	$20,000
August 2, 1882	40,000
July 5, 1884	40,000
August 5, 1886	22,500
August 11, 1888	30,000
September 19, 1890	37,500
July 13, 1892	30,000
Total	220,000

The project as originally adopted in 1881 provided for two breakwaters, one starting from Southwest Ledge, in the harbor, and running in a northerly direction toward Jameson Point, a distance of 2,640 feet, the other starting from Jameson Point and extending southward about 1,900 feet. The estimated cost was $550,000. The top of each breakwater was to be only 5 feet above the level of mean low tide.

In 1887 the project was amended so as to bring the top of the breakwater from Jameson Point to the level of high tide, leaving the other as originally designed. The estimated cost was thus increased to $650,000.

In 1890 the project was again modified. Instead of building the second breakwater from Southwest Ledge in a northerly direction, on which no work had been done, it was decided to prolong the one from Jameson Point in a southerly direction. By doing so a much larger area of the harbor would secure protection.

The estimated cost of the new project was $632,500, this being inclusive of the cost of the part already constructed.

Up to the close of the fiscal year ending June 30, 1893, there had been expended on the breakwater the sum of $199,136.45, and about 220,054 tons of stone had been placed in position. The above expenditures had resulted in protecting a part of the harbor, giving a secure harbor of refuge for many vessels that trade near this port.

During the fiscal year ending June 30, 1894, there had been expended the sum of $19,859.05.

At the close of the fiscal year 1893 the work of extending the breakwater was in progress under a contract with William S. White. Operations were continued until the close of August, 1893, when the contract was completed. Thirty-seven thousand five hundred and nineteen tons of stone were delivered under this contract, in all, building about 236 linear feet of breakwater. A small beacon was constructed to mark the end of the work. The total quantity of stone deposited in the breakwater up to the present time is 234,110 tons, and the work is practically completed to a point 2,451 feet from the shore.

Money statement.

July 1, 1893, balance unexpended	$20,863.55
June 30, 1894, amount expended during fiscal year	19,859.05
July 1, 1894, balance unexpended	1,004.50
Amount (estimated) required for completion of existing project	412,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	100,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

COMMERCIAL STATISTICS.

Receipts and shipments.

Articles.	1891.	1892.	1893.
	Tons.	*Tons.*	*Tons.*
Brick, cement, and sand	3,897	42,904	36,614
Coal	33,505	42,480	51,000
Fish and salt, etc	2,569	8,257	9,908
Grain and flour	6,147	9,620	10,822
General merchandise	67,579	28,100	64,035
Hay and straw	....	413	500
Lumber and ship timbers	24,376	27,680	29,190
Lime	160,000	97,785	130,000
Oil	....	538	605
Stone	54,778	74,397	7,605
Sawdust and ashes	....	6,071	5,404
Steel rails, iron work, and castings	....	2,172	2,323
Wood and cooperage	76,237	188,388	188,500
Ice	4,672	....	2,000
Total	433,760	528,805	538,566

Number of vessels arriving in calendar year 1893.

Steamers, coastwise:	
400 to 1,500 tons each	641
25 to 400 tons each	2,334
Sailing vessels:	
Foreign, average 90 tons each	609
Coastwise trade	4,047
For refuge only	1,300

A 11.

IMPROVEMENT OF KENNEBEC RIVER, MAINE.

Congress recognized the importance of improving the Kennebec River as early as 1827, when an appropriation was first made. Appropriations aggregating $18,500 were made between 1827 and 1852. From 1852 to 1866 no work was done by the General Government, but the citizens of Augusta within this period undertook to dredge out a channel above Sheppards Point, and they improved it in some localities, but the material was not removed a sufficient distance from the channel, and from that and other causes it filled up again.

The act of June 23, 1866, appropriated $20,000 for the improvement of the upper part of the river between Sheppards Point and Augusta, a length of about 3 miles. The project for this improvement consisted in removing rocks and straightening and deepening the channel, which was obstructed by shoals, to a depth of 8 feet up to Hallowell and 7 feet from thence to Augusta. The estimated cost was $50,000. The projected width of channel was fixed at first at 75 feet.

In 1868, after a survey of the river had been made from Augusta to Gardiner, the project was amended so as to include all that part of the river from Gardiner to Augusta, and the width fixed at 100 feet. The amended project was estimated to cost $80,000. In 1871 the project was again extended by act of Congress, which appropriated $5,000 for improving the river between Gardiner and Richmond. This part of the river it was proposed to improve so as to give 10 feet at low tide up to Gardiner. This necessitated the removal of a ledge near Nehumkeg Island, of ledges and bowlders at other points, the dredging of a channel through the Upper Sands Bar, and one near the head of Swan Island.

The estimated cost of this additional project was about $13,000.

By July 1, 1872, all the work contemplated in the various projects for improving the Kennebec from Richmond up to Gardiner had been completed. There were, however, several rocks in the main channel of the river at Lovejoy Narrows, on the east side of Swan Island, which were a source of danger to shipping. One of them, known as "Half-tide Rock," had been excavated to a depth of 8 feet at low tide, but as this gave only about 13 feet at high tide it was not sufficient to accommodate commerce. In the report of the Chief of Engineers for 1872 the removal of some of these rocks to a depth of 12 feet at mean low tide was suggested, at an estimated cost of $13,500. A survey of two of the ledges was made in 1872, when it was found they were larger than was expected, so that the estimate was increased to $30,603.61. A more accurate survey was made in 1874, and other small sunken ledges were found. In that year the adopted project consisted in removing Ledges III, IV, V, and Dry Rock, all to a depth of 12 feet at mean low tide. Ledge I (Half-tide Rock) had been completed to 12 feet in November, 1873, and Ledge II was omitted from the project, as the removal of Dry Rock seemed to render the removal of Ledge II unnecessary.

In 1877 all the dangerous rocks in Lovejoy Narrows had been removed to a depth of 12 feet at mean low tide, which completed all projected improvements in the Kennebec River.

No further work was done on the river until 1880, when a survey was made in obedience to the requirement of the harbor and river act of June 14, 1880, of Richmond Harbor, at the head of Swan Island, with a view to its improvement. The project suggested for this improvement, which was adopted in 1881, was to give a navigable channel not less than 10 feet deep at mean low water on the shoals at the upper end of Swan Island and at Hatchs Rock, about 2 miles below, and 11 feet at the lower end of Swan Island, about 5 miles below the town of Richmond.

The estimated cost of the project was $20,500. This project was completed in 1883.

In the river and harbor act of 1886 a new survey of the Kennebec River was ordered at Bath, and from Augusta to the lower end of Perkins Island. This survey was made in 1887, and a new project for the improvement of the river from Bath to Augusta was submitted. The project submitted consisted in removing the shoals at Beef Rock, at Hatchs Rock, and near South Gardiner by means of wing dams and training walls, and dredging, the removal of rocks at Bath and at Lovejoy Narrows by blasting, and the dredging of a channel through the shoals between Augusta and Gardiner, and the removal of the old piers of the bridge at Hallowell. The depths were to be as follows: At Beef Rock Shoal 12 feet, at Hatchs Rock 9 feet, at Lovejoy Narrows 18 feet, at Upper Sands Bar 12 feet, at Hallowell Shoal 10 feet, and from thence to Augusta 8 feet, all at low tide. The estimated cost of the entire project was $410,500. In 1888, an appropriation of $75,000 having been made for the improvement of the Kennebec River, a project for the expenditure of the appropriation in improving Hatchs Rock and Beef Rock Shoals was approved. Subsequently, owing to dredging which had to be done, and which was not contemplated in the original project, the estimated cost of the entire improvement was increased to $428,500. All of the appropriation made by act of September 19, 1890, was also expended on Beef Rock and Hatchs Rock Shoals and the removal of the piers of the old bridge at Hallowell.

In August, 1892, the project was revised and a general project for the improvement adopted, as follows: For a channel depth of 13 feet up as far as Sands Island; 12 feet from thence to Hinckley Shoal, and 10 feet from thence to Augusta; a steamboat channel 9 feet deep west of Swan Island, and the removal of old bridge piers at Hallowell, all the above depths being referred to mean low tide. The estimated cost of the revised project was $388,500.

The aim of the project is to be accomplished by dredging and contraction works at Beef Rock Shoal, Hatchs Rock Shoal, and Upper Sands Bar; dredging alone between Gardiner and Augusta, and rock excavation at Lovejoy Narrows.

By the river and harbor act of 1892, $100,000 were appropriated for continuing the improvement, with a provision that a sum not exceeding $5,000 may, in the discretion of the Secretary of War, be expended between the cities of Augusta and Waterville. A survey of the part of the river referred to (which is above that portion covered by the existing project) was made in 1891, and the report printed in the Annual Report of the Chief of Engineers for 1892 (pp. 541–550). The amount was too small to accomplish any material benefit, besides which there exists at Augusta a dam, the property of a private corporation, with a lock through which vessels must pass to reach the upper river. This lock should become the property of the United States before the improvement of the river above it is undertaken by the National Government. The amount ($5,000) made available by the act of 1892 is held for future allotment.

The following appropriations have been made:

March 2, 1827	$4,000
March 19, 1828	3,500
April 23, 1830	5,000
August 30, 1852	6,000
June 23, 1866	20,000
March 2, 1867	30,000
April 10, 1869	14,850
July 11, 1870	15,000
March 3, 1871	15,000
June 10, 1872	8,000
March 3, 1873	$12,000
June 23, 1874	12,000
March 3, 1875	15,000
March 3, 1881	10,000
August 11, 1888	75,000
September 19, 1890	50,000
July 13, 1892	100,000
Total	395,350

The total expenditures on the river up to June 30, 1893, were $310,208.39. The results accomplished may be stated thus:

Before the improvements were commenced, the main channel between the foot of Swan Island and Gardiner (15 miles) was obstructed by a shoal at the foot of Swan Island, with only 10 feet on it at mean low tide; by dangerous ledges in Lovejoy Narrows; by a shoal below South Gardiner, with only 8 feet of water on it at mean low tide, and by a ledge in the channel at Nehumkeg Island. This part of the river had been improved by dredging, contraction works, and removal of ledge, so as to give a good channel 12 feet deep at mean low tide as far up as Gardiner, except over the shoal below South Gardiner. A channel was dredged through this shoal to a depth of 10 feet at mean low tide, but gradual filling had since reduced this depth to 9 feet.

The steamboat channel to the westward of Swan Island had been improved by dredging and contraction works so as to give a depth of 9 feet at mean low tide. The former depth over the shoals was but 7½ feet.

The channel between Gardiner and Augusta (6½ miles) was obstructed by shoals with a depth of water on them of only 3½ feet at low summer tide. This depth was increased to 7 feet between Gardiner and Hallowell, and 6½ feet between Hallowell and Augusta. Gradual shoaling had since reduced the available channel depth to 6 feet between Gardiner and Hallowell, and to 5 feet between Hallowell and Augusta. Three old bridge piers were also removed from the channel of the river at Hallowell. Low summer tide line is about 2 feet below that of mean low tide.

The expenditures during the year ending June 30, 1894, have been $48,760.78.

At the date of the last Annual Report, work was in progress under a contract with Moore & Wright for dredging at Upper Sands Bar, and at and near Gardiner; ledge excavation at Lovejoy Narrows, under contract with Townsend & Olsen, had been commenced; and about 2,170 tons of stone, purchased in open market, had been deposited in the jetty at Beef Rock Shoal.

Dredging was continued throughout the season, and the contract with Moore & Wright was completed about the last of October, 1893. Ninety-two thousand three hundred and seventy-eight cubic yards of material, in all, were dredged under this contract, making a depth of 12 feet at mean low tide at Upper Sands Bar, Gardiner, Browns Island, and Hinckley Lower Shoal, and 10 feet at mean low tide at Hinckley Upper Shoal.

The excavation of ledge at Lovejoy Narrows was in progress during the season of 1893 until the 27th of November, when work was suspended for the winter. At the date of suspension about 611 cubic yards of rock had been taken out, or nearly one-third the total quantity contemplated by the contract. The excavation was resumed early in May, 1894, and was in progress at the close of the fiscal year. The excavated material is deposited in the jetty at Reef Rock Shoal.

The deposit of stone in the jetty at Beef Rock Shoal, which was in progress at the close of the fiscal year 1893, was completed early in August. The stone deposited in this way during the summer of 1893 amounted to 6,044 tons, practically completing the jetty.

The improvement is in the collection district of Bath, of which Bath is the port of entry. Fort Popham and the light-house on Pond Island are near the mouth of the river.

Money statement.

July 1, 1893, balance unexpended		$85,141.61
June 30, 1894, amount expended during fiscal year		48,760.78
July 1, 1894, balance unexpended		36,380.83
July 1, 1894, outstanding liabilities	$1,261.92	
July 1, 1894, amount covered by uncompleted contracts	15,899.25	
		17,161.17
July 1, 1894, balance available		19,219.66
Amount (estimated) required for completion of existing project		163,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1896		100,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

Abstract of contracts for improving Kennebec River, Maine, in force during the fiscal year ending June 30, 1894.

No.	Name and address of contractor.	Date of contract.	Subject of contract.	Price per cubic yard.
*1	Moore & Wright, Portland, Me.	Dec. 19, 1892	Dredging at Upper Sands Bar Dredging shoals at and above Gardiner.	$0.28 .40
2	Townsend & Olsen, Boston, Mass.	Feb. 7, 1893	Removal of ledges at Lovejoy Narrows.	12.47

* Contract completed.

COMMERCIAL STATISTICS.

Receipts and shipments.

Articles.	1891.	1892.	1893.
	Tons.	*Tons.*	*Tons.*
Bricks	1,903	13,500	400
Coal	123,356	150,000	162,075
Cement and plaster	335	532	415
Grain	150	195	50
General merchandise	22,400	33,000	42,801
Granite and feldspar	12,000	12,000	7,550
Hay	13,255	16,500	2,750
Ice	846,165	925,000	657,700
Iron	830	465	2,360
Lime	245	....	325
Lumber and ship timbers	186,523	111,953	91,286
Salt	2,212	....	726
Wood	1,100	....	2,500
Total	1,210,474	1,263,145	970,938

Number of vessels arriving in calendar year, 1893.

Steamers, coastwise:	
About 1,600 tons	64
About 1,400 tons	64
About 100 tons, or less	1,376
Sailing vessels, coastwise, average over 400 tons	3,200
Total	4,704
Tugs (steam) plying in the river	15
Steam ferryboats in the river	2
Vessels built during the year, gross tonnage, 7,518 (1 ship, 4 steamers, 5 schooners, 3 barges, and 2 sloops)	15

A 12.

IMPROVEMENT OF HARRASEEKET RIVER, MAINE.

The act approved March 3, 1881, provided that survey be made of this river. The survey was made in July of that year, and a report was submitted in December by the engineer of the district.

The river empties into Casco Bay at Stockbridges Point, about 12 miles northeast of Portland. From Stockbridges Point up to Westons Point the depth of water is no less than 10 feet at mean low tide, with no obstructions to navigation. From Westons Point up to Freeport Landing, a distance of 4,500 feet, the depth diminishes so that for the greater part of the distance the bottom of the river is 3½ feet out of water at mean low tide. The rise and fall of tides here is 9 feet. The project recommended in 1881 was the dredging of a channel not less than 60 feet wide and 3 feet deep at mean low tide up to Freeport, and a turning basin 180 feet wide at the head of the channel. The estimated cost of the improvement recommended was $13,000.

No appropriation was made for the work, however, and a new survey was ordered in the river and harbor act of 1888. A project for the improvement was submitted January 4, 1889. This project was on a somewhat larger scale than the one previously suggested, and contemplated a depth of channel of 5 feet at mean low tide, which would give about 14 feet at high tide.

The estimated cost of the project was $36,000.

The following appropriations have been made:

Act of September 19, 1890	$10,000
Act of July 13, 1892	16,000

The appropriation of 1892 is for completing the improvement.

No work had been done up to the close of the fiscal year ending June 30, 1893. The expenditures had been $47.80. Proposals for doing the work were opened October 3, 1892, and again November 16, 1892, but in each case the prices were considered high and all the bids were rejected.

The expenditures during the year ending June 30, 1894, were $669.20, making the total expenditures $717.

Bids for doing all the dredging covered by the existing project were again invited, and were opened September 30, 1893. A contract was made with Moore & Wright, of Portland, Me., at 17½ cents per cubic yard, the work to be done during the present season.

The river is in the collection district of Portland and Falmouth. The nearest light-house is on Halfway Rock.

Money statement.

July 1, 1893, balance unexpended		$25,952.20
June 30, 1894, amount expended during fiscal year		669.20
July 1, 1894, balance unexpended		25,283.00
July 1, 1894, outstanding liabilities	$300.00	
July 1, 1894, amount covered by uncompleted contracts	24,000.00	
		24,300.00
July 1, 1894, balance available		983.00

Abstract of proposals for dredging in Harraseeket River, Maine, September 30, 1893.

No.	Name and address of bidder.	Price per cubic yard (150,000 cubic yards), measured in scow.	Amount.
		Cents.	
1	Augustus B. Martin, Boston, Mass	28	$42,000
2	Charles H. Sonther, Boston, Mass	25	37,500
3	Moore & Wright, Portland, Me	17½	26,250
4	Hamilton & Sawyer, Chebeague, Me	25½	38,250
5	Charles W. Anthony, Fall River, Mass	21$\frac{9}{16}$	32,850

Contract made with Moore & Wright, October 24, 1893.

COMMERCIAL STATISTICS.

No statement of tonnage could be obtained.

The following letter was received in reply to a request for information as to the trade of the river:

FREEPORT, ME., *January 26, 1894*

DEAR SIR: In reply to yours of the 23d, requesting commercial statistics pertaining to the Harraseeket River for the calendar year 1893, I wish to say that the business for the past year has been about the same as it has been for the past ten years. The steamboat has made daily trips from March 1 to the last of December and two trips daily from June 20 to September 1. We can not do anything to increase our business through water transportation. I have over 100,000 paving stone, all cut and ready to ship as soon as the season opens. I want to ship these by water, but can not; shall have to ship by rail. Then I have a party who stands ready to establish a coal yard to the head of navigation, and he will do so as soon as loaded vessels can come up. Our coal consumption is increasing rapidly, and no doubt most all, if not all, would come by water. There is no reason why I can not ship 300,000 paving, thousands of tons of rough granite and building stock, and from 1,000,000 to 2,000,000 brick yearly, if vessels could come up to the landing. You will pardon me for so often making the statement of what we are going to do after the channel is dredged, but to us here in Freeport it means everything. I am sorry I can not give you further information relating to business done on the river, but as you understand there is nothing being done or will be done until the Government does what it can to help us. I will call on you the first time I am in the city, and will be pleased to give you any further information I may possess.

I am, yours, very truly,

E. B. MALLET, JR.

Lieut. Col. PETER C. HAINS.

A 13.

IMPROVEMENT OF PORTLAND HARBOR, MAINE.

The commercial importance of Portland was recognized in the early days when Congress began a system of internal improvements for the country. The first appropriations were made for the construction of a breakwater on Stamford Ledge, in Portland Harbor, according to the plan of John Anderson, of the Corps of Engineers, in 1836. Subsequent appropriations ran the aggregate up to about $166,000. The breakwater was completed in 1874, according to the plans of Col. B. S. Alexander, which plans had been submitted to and approved by a board of engineers, consisting of Col. H. Bache, Lieut. Col. George Thom, and Maj. T. L. Casey, in 1867.

The first regular appropriation for deepening the waters of the harbor was made in 1870, though by joint resolution of Congress, approved June 5, 1868, the Chief of Engineers was authorized to expend so much of the unexpended balance of the appropriation of 1866 for the breakwater as he might deem proper in excavating the middle ground near said breakwater and in otherwise protecting and improving the channel, so that the appropriation of 1866 for the breakwater, and subsequent appropriations for improving Portland Harbor, were expended partly on the breakwater and partly in dredging.

The first regular project for dredging the harbor was submitted by Col. George Thom, June 30, 1868, in which he recommended the excavation of a channel 300 feet wide through the southern slope of the middle ground to the depth of 20 feet at mean low tide, and the removal of the bar off Grand Trunk wharves to the same depth. The project was approved. The estimated cost was $28,600.

The estimated cost of completing the breakwater at the time this report was made was $59,984, and as $92,000 of the appropriation of

1866 was at that time available, no additional funds were needed over what had already been appropriated.

In 1869 an extension of the breakwater 190 feet was added to the project, and subsequently a further extension of 200 feet was ordered.

In 1870 the project for the channel improvement was amended so as to provide for a channel 400 feet wide instead of 300, and in 1871 it was still further added to by making it 500 feet wide, the extra cost of these additions to the project being $65,000.

The act of Congress of June 10, 1872, made an appropriation of $45,000 for Portland Harbor and Back Bay. The approved project for this latter improvement was estimated to cost $15,000. The improvement contemplated was the enlargement, by dredging, of the channel leading from Tukey's bridge southwardly to the stone wharves.

In December, 1872, there was added to the project a plan to dredge the inner harbor to a depth of 16 feet up to the harbor commissioner's lines, beyond which several wharves extended. The estimated cost of this additional improvement was $110,000, but it was not designed to expend it until the outer ends of the projecting wharves had been removed. By 1876 all the work projected for the improvement of the harbor had been completed except the dredging in the inner harbor in front of the harbor commissioner's lines above Merrill's Wharf.

The total expenditures up to 1876 had been $306,908.07, which expenditures had been of great benefit to the commerce of the city.

No appropriation was made between 1875 and 1881.

A resurvey of the harbor was made in 1880, which showed that the dredged channels up to that time had not deteriorated.

A new appropriation was made in 1881, and with a view to the further improvement of the harbor a project and estimate for the removal of the entire area of the shoal known as the middle ground to a depth of 21 feet, at an estimated cost of $160,000, was adopted. The work on this latter project was continued until 1885, when it was completed. The total expenditures on the entire harbor up to June 30, 1885, were $427,929.21. In 1886 the board of trade and other parties interested asked for still further improvement of the harbor to a depth of 29 feet at mean low tide. A project for this improvement, at an estimated cost of $135,000, was approved in 1886. In 1890 the project was extended to include some dredging in the upper harbor to 16 feet, at an estimated cost of $5,000.

The following appropriations have been made:

July 4, 1836, for breakwater	$10,000.00
March 3, 1837, for breakwater	25,000.00
July 7, 1838, for breakwater	26,366.00
June 23, 1866, for extending breakwater, but unexpended balance made available for excavating middle ground by joint resolution of June 5, 1868	105,111.05
July 11, 1870, for improving harbor	10,000.00
March 3, 1871, for improving harbor	40,000.00
June 10, 1872, for improving Portland Harbor and Back Bay	45,000.00
March 3, 1873, for improving harbor	50,000.00
June 23, 1874, for improving harbor	20,000.00
March 3, 1875, for improving harbor	20,000.00
March 3, 1881, for improving harbor	20,000.00
August 2, 1882, for improving harbor	35,000.00
July 5, 1884, for improving harbor	30,000.00
August 5, 1886, for improving harbor	30,000.00
August 11, 1888, for improving harbor	40,000.00
September 19, 1890, for improving harbor	40,000.00
July 13, 1892, for completing improvement	30,000.00
Total	576,477.05

The total expenditures up to June 30, 1893, were $551,336.43.

Before the improvement of the harbor was begun the greatest depth at mean low tide across the bar between the middle ground and Stamford Ledge was 16 feet, while the depth on the middle ground itself was only from 8 to 10 feet at mean low tide. The depth in the inner harbor along the front of the wharves was in places no more than 4 feet. The expenditures have resulted in removing the entire area of the middle ground up to the harbor commissioner's line, giving a wide and commodious entrance 29 feet deep at mean low tide; also in giving a depth of 16 feet at mean low tide within the inner harbor along the wharves and up to the harbor commissioner's lines, and a breakwater to protect the anchorage.

The expenditures in the fiscal year ending June 30, 1894, have been $385.22.

The total amount of dredging done in the harbor up to the end of the fiscal year ending June 30, 1894, has been about 1,708,051 cubic yards. The total amount of stone built in the breakwater is about 45,000 tons.

At the date of the last annual report all the dredging contemplated by the project had been completed. In February, 1894, the project was amended to cover the widening of the upper end of the 29-foot channel, and the opening of a 25 foot channel to connect the deep water in the lower part of the harbor with that in the upper part.

The estimate of the cost of the improvement was not increased, the balance already available being sufficient to meet the cost of the additional work. Bids for doing the new work, amounting to about 150,000 cubic yards of dredging, were opened April 21, 1894, and a contract was made May 12, 1894, with Moore & Wright, of Portland, Me., at 15¾ cents per cubic yard. The work is to be commenced by the 15th of July next.

The harbor is defended by Forts Preble, Gorges, Scammel, and a battery at Portland Head. There is a light-house on the breakwater and one at Portland Head, 3 miles distant from the city. The harbor is in the collection district of Portland and Falmouth, of which Portland is the port of entry.

Money statement.

July 1, 1893, balance unexpended		$25, 140. 62
June 30, 1894, amount expended during fiscal year		385. 22
July 1, 1894, balance unexpended		24, 755. 40
July 1, 1894, outstanding liabilities	$200. 00	
July 1, 1894, amount covered by uncompleted contracts	23, 625. 00	
		23, 825. 00
July 1, 1894, balance available		930. 40

Abstract of proposals for dredging in Portland Harbor, Maine, April 21, 1894.

No.	Name and address of bidder.	150,000 cubic yards.	
		Price per cubic yard.	Amount.
		Cents.	
1	Hamilton & Sawyer, Chebeague, Me	27	$40, 500
2	Charles H. Souther, Boston, Mass	31	46, 500
3	Lynn Dredging Co., Lynn, Mass	31	46, 500
4	Moore & Wright, Portland, Me	15¾	23, 625

Contract made with Moore & Wright, May 12, 1894.

COMMERCIAL STATISTICS.

Receipts and shipments.

Articles.	1891.	1892.	1893.
	Tons.	*Tons.*	*Tons.*
Apples	107, 801	5, 733	2, 662
Bacon, pork, and provisions	810	18, 700	18, 640
Bricks	4, 675	7, 350	6, 750
Coal	600, 000	600, 000	621, 930
Cattle on hoof	3, 185	3, 512	733
Cement and lime	14, 915	17, 165	6, 001
Cotton	2, 874	3, 815	5, 000
Cooperage	2, 345	5, 514	4, 858
Fish	13, 052	10, 000	52, 875
General merchandise and flour	482, 620	377, 417	282, 205
Grain and hay	29, 936	91, 970	111, 131
Ice	6, 154	26, 637	1, 000
Iron, machinery, and castings, lead, and tin	2, 773	7, 650	37, 462
Lumber and carriage wood	39, 162	65, 328	74, 950
Molasses and sugars	....	8, 360	2, 782
Miscellaneous and dry goods	20, 000	73, 227	36, 494
Oil and paints	20, 862	26, 531	36, 000
Sand, stone, clay, and whiting	16, 703	22, 455	23, 969
Salt, brimstone, and rags	364	4, 766	5, 635
Railroad ties	....	685	....
Printing paper and china clay	....	....	101, 728
Total	1, 368, 237	1, 376, 815	1, 432, 805

Arrivals in calendar year 1893.

Steamers:	
Coastwise, drawing 12 to 18 feet, average 1,500 tons	*834
Foreign, drawing 20 to 26 feet, average 3,400 tons	37
For refuge	57
Sailing vessels:	
Foreign, drawing 10 feet or more, average 500 tons	119
Coastwise, drawing 10 feet or more, average 500 tons	3, 581
Coastwise, drawing 10 feet, and less, average 100 tons	5, 900
For refuge	1, 500

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[*] Does not include a number of smaller steamers which ply from Portland to points in Casco Bay, 3 to 14 miles distant.

A 14.

IMPROVEMENT OF CHANNEL IN BACK COVE, PORTLAND, MAINE.

The first work done in Back Cove was ordered in the river and harbor act of 1872. The project was for dredging a channel in "Back Bay" 100 feet wide and 8 feet deep at mean low tide, from Tukeys bridge to the "Stone-shed Wharves." The estimated cost was $10, 000. The work was completed in January, 1874.

The act of August 5, 1886, appropriated $26,250 for continuing the improvement of Back Cove. A survey was made in 1886, and a project adopted having in view the straightening and deepening of the channel to a depth of 12 feet at mean low tide and to a width of 300 feet, following the harbor commissioner's lines along that part of the cove which borders the city, a distance of about 5,600 feet, with a turning basin at the upper end. The estimated cost of this project was $181,000, which, in 1888, was revised in consequence of a trifling modification in the location and put at $180,000. This project is now in process of execution.

The following appropriations have been made:

Act of—

June 10, 1872, for improvement of Portland Harbor and Back Bay	$45,000
August 5, 1886	26,250
August 11, 1888	25,000
September 19, 1890	25,000
July 13, 1892	20,000

When work under the existing project was commenced the channel had a depth at low tide of about 8 to 10 feet for about one-half its length; in portions of the remaining length the depth at low tide did not exceed 1 foot.

The expenditures to the close of the fiscal year ending June 30, 1893, under the existing project, amounted to $76,330.21. At that date the condition of the work was as follows: The channel had been extended for a distance of about 1,400 feet to a width of 160 feet; about 1,400 feet to a width of 265 feet, and the remaining length to a width of 90 feet, with a turning basin, 400 feet wide, at the upper end, all to the depth of 12 feet at mean low tide.

The expenditures during the fiscal year ending June 30, 1894, were $204.92.

Practically, there was no work done during the last fiscal year.

A contract was made January 11, 1894, with Charles W. Anthony, of Fall River, Mass., to continue the dredging, to the extent of about 110,000 cubic yards, at 14.2 cents per cubic yard, the work to be done during the present season.

Back Cove is a part of Portland Harbor, and is therefore in the same collection district; is defended by the same forts, and the same light-houses are near it as are given for Portland Harbor.

Money statement.

July 1, 1893, balance unexpended		$19,919.79
June 30, 1894, amount expended during fiscal year		204.92
July 1, 1894, balance unexpended		19,714.87
July 1, 1894, outstanding liabilities	$200.00	
July 1, 1894, amount covered by uncompleted contracts	15,620.00	
		15,820.00
July 1, 1894, balance available		3,894.87
Amount (estimated) required for completion of existing project		83,750.00
Amount that can be profitably expended in fiscal year ending June 30, 1896		50,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

Abstract of proposals for dredging in Back Cove, Portland Harbor, Maine, December 29, 1893.

No.	Name and address of bidder.	Price per cubic yard (110,000 cub. yds.) measured in scow.	Amount.
		Cents.	
1	Moore & Wright, Portland, Me	16	$17,600
2	Hamilton & Sawyer, Chebeague, Me	28	30,800
3	Charles W. Anthony, Fall River, Mass	$14\frac{3}{15}$	15,620
4	Augustus B. Martin, Boston, Mass	30	33,000
5	Charles H. Souther, Boston, Mass	25	27,500

Contract made with Charles W. Anthony, January 11, 1894.

COMMERCIAL STATISTICS.

Receipts and shipments.

Articles.	1891.	1892.	1893.
	Tons.	*Tons.*	*Tons.*
Coal	11,586	35,771	34,063
Clay and sand	15,868	19,025	22,652
Granite	635		
Wood		125	
Railroad ties		560	
Pipe			3,050
Total	28,089	55,481	59,765

Number of arrivals in calendar year 1893.

Sailing vessels drawing—

About 18 feet, 1,000 to 1,500 tons each	3
From 12 to 16 feet, 500 to 1,000 tons each	47
About 12 feet, 300 to 500 tons each	25
About 10 feet, 200 to 500 tons each	16
Less than 10 feet, less than 100 tons each	172
Total	263

A 15.

IMPROVEMENT OF SACO RIVER, MAINE.

The first appropriation made for the improvement of the Saco River was in 1827, when $7,000 was appropriated for the erection of piers, placing beacons and buoys, and removing obstructions at and near the entrance to the harbor. With the expenditure of these funds it appears that 12 piers were constructed within the river, the object of which was to keep vessels from drifting onto the rocks and ledges, and 2 outside piers, which were evidently intended for breakwaters. No further appropriations were made until 1866, when an appropriation of $40,000 was made for continuing the repairs of piers in the Saco River.

In 1866 a plan was proposed by Mr. George Davidson, of the Coast Survey, for the construction of 2 stone piers conducting the river to the sea in a northeasterly direction, at an estimated cost of $40,000. In the same year Maj. B. S. Alexander, of the Corps of Engineers, submitted a plan for the construction of a breakwater between the 2 outside piers, 2,915 feet in length, 12 feet above low tide, the outer face to be of cut granite and the inner of rubblestone, the estimated cost of which was $192,500. The project of Maj. Alexander was modified at the suggestion of Col. George Thom, Corps of Engineers, by adding to it the repairing and rebuilding of the inside piers, the total cost of the entire project being estimated at $211,701. The latter project was approved March 28, 1867, with the condition that the position of the breakwater should first be determined by a board of engineers. Such a board, consisting of Maj. Casey, Lieut. Col. Thom, and Col. H. Bache, approved the location proposed by Maj. Alexander, Corps of Engineers. The estimated cost was subsequently increased to $270,000, and in 1868 to $320,000.

The project in 1868 was the construction of the breakwater at the mouth of the river, the removal of sunken rocks, and the rebuilding of some of the most important piers in the river. The coping or paving of the outer slopes of the breakwater was afterwards dispensed with, and some of the other work was apparently done at a lower cost than the estimates, so that the entire project was completed in 1873 at a total cost of $169,275.

Nothing more was done from 1873 to 1882. In the latter year a resurvey of the breakwater was ordered by act of Congress. This survey was made in 1883 under direction of Col. Blunt, Corps of Engineers, and an estimate submitted for extending the breakwater out to Sharps Ledge, raising and repairing the one in existence, constructing another of less height on the south side of the entrance, and for dredging. The total estimated cost of the improvement was $356,000. The resurvey showed that the breakwater did not prevent the accumulation of sand on the south side of it, so that the bar had again become an obstruction.

In 1884 an appropriation of $15,000 was made for improving breakwater at mouth of Saco River and repairs to same. This was a single item in the foregoing estimate, and the improvements and repairs suggested were estimated to cost $70,000, so that the project for improvement at the mouth of the river became repairing and raising the existing breakwater to a height of 15 feet above mean low tide and a width of 12 feet on top.

The same act of Congress that made an appropriation for the breakwater ordered a preliminary examination and survey of Saco River. A report of this survey was submitted October 16, 1885, and a project for improving the navigation of the river proper from its mouth to the towns of Saco and Biddeford was suggested, at an estimated cost of $50,000. This amount was expected to give a continuous channel of 6 feet at mean low tide to the head of navigation from the bar.

In 1886 two appropriations were made, one for the river proper and the other for the repair and completion of the breakwater. The same was done in 1888. In 1889 the engineer recommended that the two projects be combined in one. The revised estimate of the cost of the two was then put at $185,000—$30,000 to complete the breakwater and $155,000 to give 6 feet at mean low tide from the sea to Biddeford and Saco, at the head of navigation. This estimate included the construction of a jetty on the south side of the mouth of the river. The appropriation made in 1890 was understood to be for continuing work on the combined project.

The following appropriations have been made:

March 2, 1827, for piers, buoys, and removing obstructions at and near entrance	$7,000
June 23, 1866, for repairing piers	40,000
March 2, 1867, for improving river	40,000
July 25, 1868, for improving river	20,000
April 10, 1869, for improving river	22,275
July 11, 1870, for improving river	10,000
March 3, 1871, for improving river	15,000
June 10, 1872, for improving river	15,000
July 5, 1884, for breakwater	15,000
August 5, 1886, for breakwater	12,500
August 5, 1886, for improving river	12,500
August 11, 1888, for breakwater	12,500
August 11, 1888, for improving river	10,000
September 19, 1890, for improving river, including breakwater and jetty	65,000
July 13, 1892, for improving river, including breakwater	25,000
Total	321,775

The total expenditures on both river and breakwater up to June 30, 1893, were $291,697.29.

The river before the improvement was begun was obstructed at its mouth by a bar on which there was only about 2 feet of water at low tide, though much of the river was deeper, and by ledges and bowlders. The swift currents also tended to sweep vessels on the rocks and ledges.

The expenditures up to June 30, 1893, have resulted in removing the dangerous ledges, constructing piers against which vessels could touch without danger of damage, the construction of a substantial breakwater on the north side of the entrance, and the construction of a jetty, to contract the channel way. on the south side.

The expenditures during the fiscal year ending June 30, 1894, have been $15,364.53.

At the date of the last Annual Report the construction of two jetties—one at the head of Cow Island and one just below the island—was in progress under a contract with John F. Hamilton. The contract was completed by the latter part of November, 1893. Eight hundred and four fascines and 17,065 tons of stone were used in the construction of the two jetties.

Work under contract with Joseph H. Curit for extending the jetty on the south side of the entrance, which was in progress at the close of the fiscal year 1893, was completed August 12, 1893. Fifteen thousand five hundred and ninety-eight tons of stone in all were delivered under this contract, and with its completion the jetty had been built for a distance of about 4,500 feet from the shore. The effect has been to obtain deeper water than was formerly found, though the projected depth has not yet been fully secured.

The jetties constructed at and near Cow Island were with a view to securing and maintaining a greater channel depth by contraction. The object has in a measure already been accomplished, but proposals were opened June 16, 1894, for dredging about 50,000 cubic yards of material from the channels at Factory Island and at and near Cow Island.

Saco River is in the collection district of Saco, Me., of which Saco is the port of entry. The nearest light-house is Wood Island.

Money statement.

July 1, 1893, balance unexpended	$30,077.71
June 30, 1894, amount expended during fiscal year	15,364.53
July 1, 1894, balance unexpended	14,713.18
July 1, 1894, outstanding liabilities	2,487.47
July 1, 1894, balance available	12,225.71
Amount (estimated) required for completion of existing project	72,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	50,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

Abstract of proposals for dredging in Saco River, Maine, June 16, 1894.

No.	Name and address of bidder.	50,000 cubic yards.	
		Price per cubic yd.	Amount.
		Cents.	
1.	Columbian Dredging Co., Boston, Mass	20	$10,000
2.	Robert Hamilton, Chebeague, Me	37	18,500
3.	Moore & Wright, Portland, Me	20	10,000

Proposal of Moore & Wright accepted.

Abstract of contracts for improving Saco River, Maine, in force during fiscal year ending June 30, 1894.

No.	Name and address of contractor.	Date of contract.	Subject of contract.	Price.
				Cents.
1.	Joseph F. Curit, Chebeague, Me. *	July 25, 1892	Extension of stone jetty at mouth of river	†90
2.	John F. Hamilton, Portland, Me. *	Dec. 17, 1892	Construction of riprap jetties near Cow Island	†93 ‡75

* Contract completed. † Per ton for stone. ‡ For each fascine.

COMMERCIAL STATISTICS.

Receipts and shipments.

Articles.	1891.	1892.	1893.
	Tons.	*Tons.*	*Tons.*
Bricks	6,000	6,100	9,700
Coal	40,724	39,266	48,962
Cement and lime	485	360	249
Iron	1,684	972	453
Lumber	80	120	....
Molding sand	480	250	272
Powder and ashes	92	....	....
Roofing gravel	220	40	101
Phosphate	....	....	28
Total	49,765	47,108	59,765

A 16.

IMPROVEMENT OF HARBOR AT YORK, MAINE.

York Harbor is located at the mouth of York River, a small stream that empties into the Atlantic Ocean about 10 miles east of Portsmouth, N. H.

A survey was made in 1884, and a report thereon submitted in February, 1885, in which a project of improvement was suggested. This project had for its object (1) the removal by dredging of part of the spit off the southwest point of Stage Neck; (2) the removal by dredging of part of a sand shoal off Bragdons Island, and (3) the removal of the upper shoal just north of Bragdons Island. The object of the improvement was to widen and straighten the channel, which was very crooked and difficult to navigate, and give a navigable channel of 10 feet at mean low tide. The estimated cost of the project was $25,000.

The project was approved in 1886, after the first appropriation for the work was made, and its execution was entered upon.

In 1887 it was found that the prices on which the estimate was based were too low, so the estimate was revised and increased to $30,000.

Subsequently it was found that part of the spit off Stage Neck was ledge instead of loose rock and gravel, and in 1888 the estimate was again revised and made $44,000.

The following appropriations have been made:

August 5, 1886	$15,000
August 11, 1888	10,000
September 19, 1890	10,000
July 13, 1892, for completing improvement	9,000

The total expenditures up to June 30, 1893, have been $35,023.94.

With these expenditures the following work has been accomplished: Part of the shoal at the entrance to the harbor has been removed by dredging and rock excavation to a depth of 10 feet at mean low tide, thereby increasing the width of the channel at the narrowest point from 90 feet to about 150 feet. A part of the shoal in the upper part of the harbor has also been removed by dredging to the same depth, increasing the width of the 10-foot channel at that point about 100 feet.

The expenditures during the fiscal year ending June 30, 1894, were $8,976.06, exhausting the funds.

Under the contract with Augustus B. Martin, referred to in the last Annual Report, dredging operations were commenced June 29 and continued until July 20, 1893, when the contract was completed. Five thousand eight hundred and seventy-eight cubic yards of material were dredged at the entrance, and 12,143 cubic yards in the harbor basin.

The appropriation of 1892, which was for completing the improvement, having been expended, the project is regarded as completed.

The improvement is in the collection district of York. The nearest light-house is Cape Neddick, 3 miles distant.

Money statement.

July 1, 1893, balance unexpended	$8,976.06
June 30, 1894, amount expended during fiscal year	8,976.06

COMMERCIAL STATISTICS.

Receipts and shipments.

Articles.	1891.	1892.	1893.
	Tons.	*Tons.*	*Tons.*
Apples		90	100
Bricks	3,500	1,800	5,500
Coal	400	600	1,500
Farm produce	100	90	150
Fish and oysters	100		175
Grain	500		1,000
General merchandise	500	650	1,050
Hay, wood, and potatoes	1,100	1,500	1,800
Lime and cement	150		350
Lumber		600	10,000
Total	6,350	5,330	21,625

Number of vessels arriving in calendar year, 1893.

Sailing vessels—	
Drawing 9 feet	75
For refuge only	50

A 17.

IMPROVEMENT OF BELLAMY RIVER, NEW HAMPSHIRE.

The Bellamy River to the head of navigation is a tidal branch of Great Bay, which empties into the Piscataqua River at Dover Point, 4 miles above the bridge at Portsmouth, N. H. At low water the channel of the river is too shoal for any navigation, except for a short distance from its mouth. The distance over which improvements are projected is about 2½ miles.

A survey was made of the Bellamy River in 1887 and a project of improvement suggested, at an estimated cost of $28,000, which was increased in 1891 to $35,000. The project is to secure a channel 50 feet wide and 5 feet deep at mean low tide from the mouth of the river up to Sawyer's Mill at Dover. The rise and fall of the tide being about 7 feet, a high-water navigation of 12 feet will be secured.

The above project was adopted in 1888 and its execution is now in progress.

The following appropriations have been made:

August 11, 1888	$10,000
September 19, 1890	10,000
July 13, 1892	7,500

The expenditures up to the close of the fiscal year ending June 30, 1893, have been $19,681.61. These expenditures have resulted in giving a channel from the mouth of the river up to about 1 mile above Robert's brickyard, 50 feet wide and 5 feet deep at low tide. In other words, about 1 mile was added to the navigable part of the river.

There were no expenditures during the fiscal year ending June 30, 1894, and there were no operations.

Proposals for dredging were opened November 16, 1892, but, the prices being high, all bids were rejected. The work will be readvertised.

There is no trade on the river at present beyond the brickyard, near which the first dredging was begun, but it is thought that the improvement of the river in the upper part will develop the manufacture of bricks, an extra good quality of which, it is reported, can be made here; and it will also enable coal and other mill supplies to be shipped to Sawyer's Mill and the western part of Dover at a less cost than at present.

Money statement.

July 1, 1893, balance unexpended	$7,818.39
July 1, 1894, balance unexpended	7,818.39
Amount (estimated) required for completion of existing project	7,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	7,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

A 18.

IMPROVEMENT OF COCHECO RIVER, NEW HAMPSHIRE.

The Cocheco River is a branch of the Piscataqua, which empties into the sea at Portsmouth, N. H. Dover is the head of navigation, and here the mean rise and fall of tides is about 7 feet.

From Dover to the Lower Narrows, a distance of about 1½ miles, the river was much obstructed by bowlders, ledges, and shoals, the depth of water being only from 6 inches to 2 feet at mean low tide. Appropriations amounting to $10,000 were made as early as 1836 and 1837 "for deepening the channel of the Cocheco branch of the Piscataqua, leading into Dover Harbor," but the records do not show what work was accomplished.

The first regular project for the improvement of the river was based on an examination made in 1870, and consisted in making a channel not less than 40 feet wide and 4 feet deep at mean low tide from the lower narrows up to Collins Wharf, at the head of the upper narrows. The estimated cost of the project was $45,000.

Subsequently more accurate and extended surveys having shown the practicability of extending the improvement up to Packets Landing and thence to make a channel 2 feet deep at low tide, corresponding to 9 feet at high tide, and a width of 30 feet, up to the bridge at the head of navigation, the estimate was increased, to suit the latter project, to $85,000. This sum was appropriated between 1871 and 1878, and by 1879 all the improvements at that time contemplated were completed.

These improvements opened up a large commerce, employing large vessels where formerly flatboats had been used. Owing to the abrupt turns, however, in the channel at the Lower Narrows these vessels had difficulty in passing that place. The larger vessels that came into use required a wider and deeper channel.

A new project was therefore adopted providing for making a cut-off channel through Alleys Point, with straight connecting channels above and below, and widening to 60 feet and deepening to 5 feet the existing channels through Trickeys and Clements Point shoals; $28,000 were appropriated and expended in making the "cut-off" through Alleys Point. The other work of blasting and removing rock and dredging in the upper portions of the river was estimated to cost $47,000 more. This second project was completed in 1888.

The act of August 11, 1888, ordered another survey to be made of the river. The report of this survey is dated December 14, 1889. The large increase in trade seemed to justify still further improvement of the river, and accordingly a new project was submitted, suggesting an improvement that looks to obtaining a channel depth of 7 feet, increasing to 7½ feet in rock, the channel to have a minimum width of 50 feet where confined in rock, increasing to 60 and 75 feet where the material is less expensive to remove. This last project is estimated to cost $175,000.

The following appropriations have been made for the improvement of this river:

July 4, 1836	$5,000
March 3, 1837	5,000
March 3, 1871	10,000
June 10, 1872	10,000
March 3, 1873	10,000
June 23, 1874	10,000
March 3, 1875	25,000
August 14, 1876	14,000
June 18, 1878	6,000
August 2, 1882	$28,000
July 5, 1884	28,000
August 5, 1886	10,000
August 11, 1888	9,000
September 19, 1890	25,000
July 13, 1892	15,000
Total	210,000

The total expenditures on the improvement of the river up to June 30, 1893, have been $194,434. These expenditures have resulted in giving a channel through the rocky bed of the river 5 feet deep and 40 feet wide in the narrowest parts, where before the depth was only from 6 inches to 2 feet.

The upper end of the channel at Dover has been deepened to 7 feet at mean low tide for a length of 1,200 feet, with widths varying from 100 to 140 feet. Portions of the channel above and below Clements Wharf, of a total length of 600 feet, have also been dredged to the same depth.

The expenditures during the fiscal year ending June 30, 1894, have been $584.68.

A contract was made March 20, 1894, with Rogers & Fitzpatrick, of Plattsburg, N. Y., for the excavation of about 2,000 cubic yards of ledge in the Upper Narrows at $6.44 per cubic yard. The contractor began work early in May, 1894, and by the close of the year had made considerable progress.

The improvements in the navigation of the Cocheco have been of great benefit to the people of Dover and the vicinity. In the item of coal alone it is reported that not less than 35,000 tons are supplied annually at a saving of 50 cents per ton, which could not have been done had no improvement been made.

Money statement.

July 1, 1893, balance unexpended		$15,566.00
June 30, 1894, amount expended during fiscal year		584.68
July 1, 1894, balance unexpended		14,981.32
July 1, 1894, outstanding liabilities	$300.00	
July 1, 1894, amount covered by uncompleted contracts	12,880.00	
		13,180.00
July 1, 1894, balance available		1,801.32
Amount (estimated) required for completion of existing project		135,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896		50,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

Abstract of proposals for removal of ledge in Cocheco River, New Hampshire, March 5, 1894.

No.	Name and address of bidder.	2,000 cubic yards ledge.	
		Price per cubic yard.	Amount.
1	Charles H. Southor, Boston, Mass	$12.50	$25,000
2	Thomas Symonds, Manchester, Mass	9.49	18,980
3	Townsend & Johnston, Somers Point, N. J	8.86	17,720
4	Rogers & Fitzpatrick, Plattsburg, N. Y	6.44	12,880

Contract made with Rogers & Fitzpatrick, March 20, 1894.

COMMERCIAL STATISTICS.

Receipts and shipments.

Articles.	1891.	1892.	1893.
	Tons.	*Tons.*	*Tons.*
Apples		150	
Brick	40,056	40,000	31,500
Coal	26,656	27,855	29,983
Cement, lime, and plaster	1,810	1,950	2,025
General merchandise			200
Iron	390		
Lumber	1,500	1,600	3,000
Phosphates	150	150	225
Sand (molding)	100	80	
Total	70,662	71,785	66,933

Vessels arriving in calendar year 1893.

Sailing vessels, coastwise—400 to 500 tons each	35
Less than 400 tons each	68
Steam tugs	3
Barges	1

A 19.

HARBOR OF REFUGE AT LITTLE HARBOR, NEW HAMPSHIRE.

At the instance of members of the Marine Society, and the Board of Trade, and other citizens of Portsmouth, a survey of this harbor was made in 1882 by Col. George Thom, Corps of Engineers. The improvement desired at that time was to have the channel of entrance opened to a depth of 9 feet at mean low tide for a width of 100 feet and to have the inner basin enlarged to a width of 300 feet for a length of about 700 feet and the dredged channel and basin protected by a rubblestone breakwater. The estimated cost of the project was $33,000.

The act of Congress of July 5, 1884, directed a preliminary examination and survey to be made with a view to its improvement as a harbor of refuge. This examination was made in the latter part of the year 1884, and an enlarged project submitted for the improvement, the estimated cost of which was $150,000. The former project was not regarded by the district engineer as sufficient to accomplish satisfactory results, and the latter he regarded as too costly to justify the Government in undertaking it. The former project, however, was adopted in 1886, and its execution entered upon.

In 1887 the engineer recommended that the project be enlarged, as the old project did not seem to meet the needs of those interested. A new project was therefore suggested, providing for the construction of two breakwaters, one on the north side and the other on the south side of the entrance, and the dredging of an anchorage behind them of about 49 acres to a depth of 12 feet at mean low tide. The estimated cost of the enlarged project was $235,000.

The act of 1888 made an appropriation of $20,000 for the work on the enlarged plan. Before the improvement was undertaken the depth of water in the harbor was only about 6 feet at low tide, and the anchorage was small in area and exposed to the full force of the sea, which is heavy when the winds are strong from the northeast. The object of the improvement is to form a harbor of refuge for small coasters and other vessels that get caught outside and are unable to get into the harbor of Portsmouth on account of the strong ebb tide which sets out to sea. It is said that a number of wrecks have occurred which need not have happened if such a harbor had been in existence.

The following appropriations have been made:

August 5, 1886	$10,000
August 11, 1888	20,000
September 19, 1890	40,000
July 13, 1892	30,000

The total expenditures up to June 30, 1893, were $45,490.86. The results accomplished up to that date were the dredging of a part of the area intended for anchorage ground under the new project and the partial construction of the breakwater on the south side of the entrance.

The expenditures during the fiscal year ending June 30, 1894, have been $44,018.92.

At the date of the last annual report work was in progress under two contracts—one with George Willett Andrews for raising and widening the breakwater on the south side of the entrance, and the other with Moore & Wright for dredging.

The construction of the breakwater was completed the last of October, 1893. The total quantity of stone delivered under the contract was 14,962 tons.

The dredging, under contract with Moore & Wright, continued until January 6, 1894, when 145,137 cubic yards of material had been removed. Under this contract the channel or anchorage was widened 200 feet, to the depth of 12 feet at mean low tide.

March 19, 1894, a contract was made with William S. White, of Rockland, Me., for the construction of the breakwater on the north side of the entrance. The work was commenced on the 15th of May, and was in progress at the close of the year.

There is no commerce, properly considered as such, in Little Harbor. The work is intended as a harbor of refuge, and will doubtless be used only in case of necessity by small coasters which can not reach Portsmouth Harbor in northeasterly storms.

Money statement.

July 1, 1893, balance unexpended		$54,509.14
June 30, 1894, amount expended during fiscal year		44,018.92
July 1, 1894, balance unexpended		10,490.22
July 1, 1894, outstanding liabilities	$300.00	
July 1, 1894, amount covered by uncompleted contracts	10,000.00	
		10,300.00
July 1, 1894, balance available		190.22
Amount (estimated) required for completion of existing project		135,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896		25,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

Abstract of proposals for construction of stone breakwater at Little Harbor, New Hampshire, March 5, 1894.

No.	Name and address of bidder	Beacon, 71 tons; price per ton.	Top course, 890 tons; price per ton.	Body of breakwater, 5,270 tons; price per ton.	Amount.
1	Townsend & Johnston, Somers Point, N. J	$1.98	$1.98	$1.98	$12,337.38
2	Rockport Granite Company, Rockport, Mass	3.64	3.59	1.89	13,413.84
3	George Willett Andrews, Biddeford, Me	2.88	2.88	2.09	13,781.98
4	Joseph H. White, Boston, Mass	3.34	3.34	1.93	13,380.84
5	Hamilton & Doyen, Portland Me	3.75	4.00	2.20	15,894,55
6	William S. White, Rockland, Me	1.96	1.96	1.96	12,212.76

Contract made with William S. White, March 19, 1894.

Abstract of contracts for improving Little Harbor, New Hampshire, in force during the fiscal year ending June 30, 1894.

No.	Name and address of contractor.	Date of contract.	Subject of contract.	Price.
*1	George Willett Andrews, Biddeford, Me.	July 12, 1892	Raising and widening breakwater at Frost Point.	†$1.11
*2	Moore & Wright, Portland, Me	Feb. 24, 1893	Dredging channel to 12 feet at mean low tide.	‡.19
3	William S. White, Rockland, Me	Mar. 19, 1894	Construction of breakwater at Jerry's Point.	†1.96

* Contract completed. † Per ton for stone. ‡ Per cubic yard in scow.

APPENDIX B.

IMPROVEMENT OF RIVERS AND HARBORS IN EASTERN MASSACHUSETTS.

REPORT OF LIEUT. COL. S. M. MANSFIELD, CORPS OF ENGINEERS, OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1894, WITH OTHER DOCUMENTS RELATING TO THE WORKS.

IMPROVEMENTS.

1. Newburyport Harbor, Massachusetts.
2. Merrimac River, Massachusetts.
3. Powow River, Massachusetts.
4. Ipswich River, Massachusetts.
5. Essex River, Massachusetts.
6. Harbor of refuge, Sandy Bay, Cape Ann, Massachusetts.
7. Gloucester Harbor, Massachusetts.
8. Manchester Harbor, Massachusetts.
9. Salem Harbor, Massachusetts.
10. Lynn Harbor, Massachusetts.
11. Winthrop Harbor, Massachusetts.
12. Mystic and Malden rivers, Massachusetts.
13. Boston Harbor, Massachusetts.
14. Weymouth River, Massachusetts.
15. Hingham Harbor, Massachusetts.
16. Scituate Harbor, Massachusetts.
17. Plymouth Harbor, Massachusetts.
18. Kingston Harbor, Massachusetts.
19. Wellfleet Harbor, Massachusetts.
20. Provincetown Harbor, Massachusetts.
21. Chatham Harbor, Massachusetts.
22. Removing sunken vessels or craft obstructing or endangering navigation.

UNITED STATES ENGINEER OFFICE,
Boston, Mass., July 5, 1894.

GENERAL: I have the honor to transmit herewith annual reports for the works of river and harbor improvements in my charge for the fiscal year ending June 30, 1894.

Very respectfully, your obedient servant,

S. M. MANSFIELD,
Lieut. Col. of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

B 1.

IMPROVEMENT OF HARBOR AT NEWBURYPORT, MASSACHUSETTS.

Newburyport is situated on the south bank 2½ miles, approximately, from the mouth of the Merrimac River. The river empties into the Atlantic Ocean midway between Cape Ann and Portsmouth, or about 30 miles a little east of north from Boston in a direct line.

The outlet of the river, between Plum Island and Salisbury Point, is 1,000 feet wide and 30 feet deep at mean low water. At a distance of nearly a mile outside lies a sandy bar, thrown up by wave action, through which, previous to the improvement, a channel, variable in position and depth, was maintained by the current of the river, increased by the tidal prism in a large interior basin, due to a range of tides equaling 8½ feet.

For 1,000 feet outward from the gorge toward the crest of the bar the current was able to maintain a channel of navigable width and 18 feet deep at mean low water, and for a farther distance of 1,500 feet a channel 12 feet deep. From the 18-foot contour line on the inside to the same on the outside the distance was 4,000 feet, and between the 12-foot contours the distance was 3,000 feet.

The depth on the crest of the bar was generally less than 7 feet at mean low water.

The object of the improvement is to create through the outer bar a channel 1,000 feet wide and at least 17 feet deep at mean low water, so that vessels may cross the bar and find a harbor at any stage of the tide with as great draft as can reach Newburyport by the river at high tide.

The project submitted September 16, 1880, proposed two converging rubblestone jetties, their outer ends parallel for 1,000 feet and about the same distance apart, and the protection of the beach in their vicinity. This was modified in 1882 so as to provide for the partial closing of Plum Island Basin with a timber dike about 800 feet long and 5½ feet above mean low water.

The direction of the south jetty and the character of the shore protection was modified in 1883. The north jetty, from Salisbury Beach, is to be 4,000 feet long, approximately, and the south jetty, from Plum Island, is to be 2,400 feet, approximately.

Both are 15 feet wide on top, which is in a plane 12 feet above mean low water. The two jetties have slopes of 1 on 2 on the sea side and of 1 on 1 on the harbor side.

A map showing the location of the jetties is published in the Annual Report of the Chief of Engineers for 1885. Their form and dimensions are shown in the report for 1881. The location and details of construction of the dike are given in the report for 1883. The estimated cost of the improvement was $375,000.

The total appropriations to date are $277,500.

The amount expended to June 30, 1893, was $251,841.87.

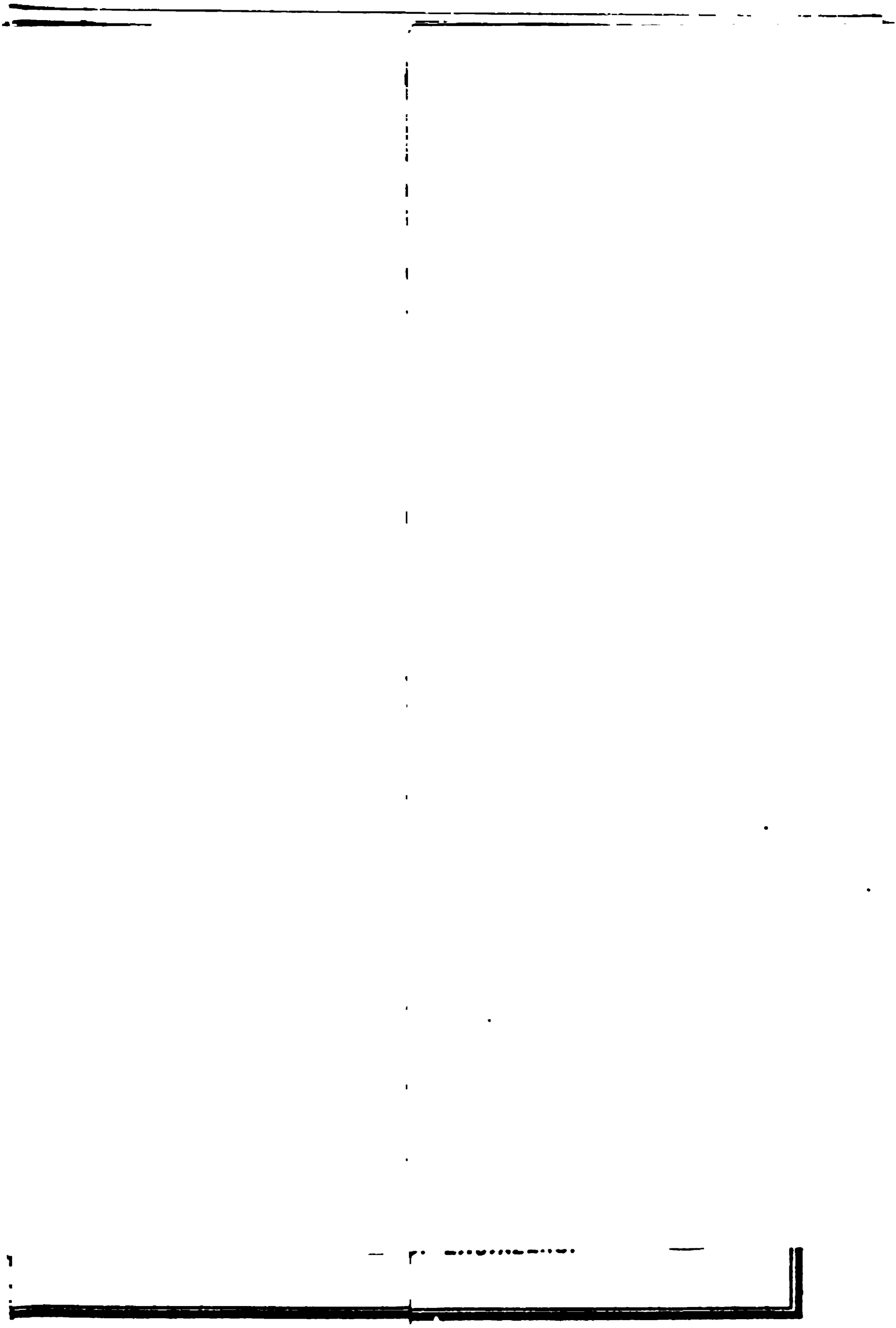
On June 30, 1893, the condition of the improvement was as follows: The north jetty was 2,510 feet long, fully completed, and partly completed for an additional length of 165 feet; the south jetty was completed for 1,077 feet, and partly completed for an additional distance of 223 feet, and its shore end was strengthened by a sand catch; the dike was completed so far as was prudent for its safety; it was 817 feet long, 5½ feet high above mean low water, except that near its center a weir had been left, 150 feet long, its sill 2 feet above mean low water.

Operations were in progress under a contract with Mr. George Willett Andrews, of Biddeford, Me., to deposit in the north jetty 15,000 tons of rubblestone; work under this contract was continued during the year, a total of 14,444 tons of stone being deposited to the date of this report.

On June 30, 1894, the north jetty is 2,705 feet long, fully completed, and the south jetty and dike are in the same condition as on June 30, 1893.

The annual survey of the bar was made early in June, 1894, and by comparison with the survey of 1893, it is found that the channel over the bar at its outer end has swung still farther to the southward; the depth on the bar and the outside contours have not altered; and that inside the bar the channel has steadily improved.

To complete the improvement an appropriation of $97,500 will be required, all of which could be expended to advantage during the fiscal year ending June 30, 1896, in the extension of both jetties to their full projected lengths.



The Friedenwald Co., Photo Lith., Balto., Md. Eng. 58 3.

The advantages to be derived from the completion of the project are the deepening and widening of the channel across the bar, thereby affording a harbor of refuge on the inside of Salisbury Beach and giving easy access at high tide to the wharves at Newburyport for vessels drawing 17 feet, approximately.

This work is located in the collection district of Newburyport, Mass., of which Newburyport is the port of entry. The nearest light-house is on Plum Island, at the entrance of the harbor.

The accompanying commercial statistics for the fiscal year have been furnished by the collector of customs for Newburyport, Mass.

The dates and amounts of appropriations for this work are as follows:

Act of—	
June 14, 1880	$50,000
March 3, 1881	40,000
August 2, 1882	40,000
July 5, 1884	40,000
August 5, 1886	37,500
August 11, 1888	25,000
September 19, 1890	25,000
July 13, 1892	20,000
Total	277,500

Money statement.

July 1, 1893, balance unexpended	$25,658.13
June 30, 1894, amount expended during fiscal year	17,881.97
July 1, 1894, balance unexpended	7,776.16
July 1, 1894, outstanding liabilities	6,716.07
July 1, 1894, balance available	1,060.09
Amount (estimated) required for completion of existing project	97,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	97,500.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

COMMERCIAL STATISTICS.

Amount of revenue collected 1892, $364.96; 1893, $918.01; 1894, ———.

Shipping.	1892.		1893.		1894.	
	No.	*Tons.*	*No.*	*Tons.*	*No.*	*Tons.*
Entrances:						
Foreign	3	387	2	140	7	889
Domestic						
Clearances:						
Foreign	4	485	13	2,362	13	
Domestic	16	4,085	1	399		

Imported.	1892.	1893.	1894.
	Tons.	*Tons.*	*Tons.*
Coal	563		1,554
Lumber	* 135,000	* 34.260	
Laths		† 98,600	
Miscellaneous		115	

* Feet. † In number.

A large quantity of coal is annually landed at this port from coastwise vessels, the arrivals and clearances of which are not recorded, and statistics can not be given. Vessels drawing from 10 to 14 feet frequent the harbor.

B 2.

IMPROVEMENT OF MERRIMAC RIVER, MASSACHUSETTS.

The mouth of the Merrimac River is 15 miles northwest from Cape Ann, Massachusetts. Tide water extends up it a distance of 19 miles, or to the foot of the "Upper Falls," 1½ miles above Haverhill, Mass.

Seven incorporated cities and the largest mills in New England are directly interested in this improvement.

Before improvement the channel was narrow and crooked, and much obstructed by ledges, bowlders, and shoals.

At mean low water vessels drawing not to exceed 7 feet could enter the river and proceed to South Amesbury, 9 miles from the mouth. The sea bar at the mouth of the river has been improved under specific appropriations for the improvement of Newburyport Harbor, while many sunken rocks and wrecks of piers and vessels lying inside the bar have been removed by general appropriations for the improvement of the river.

The object of the improvement is to widen, straighten, and deepen the natural channel of the river from the bar to the head of tide water.

The rise or fall of the tide at the mouth is 7.7 feet; at Haverhill bridge, 4 feet.

No plan of the river above Newburyport has been published in the reports of the Chief of Engineers.

The project originally adopted in 1870 proposed to remove obstructions from the Upper and Lower Mitchells Falls, and to remove the Gangway Rock and the "Boilers" in Newburyport Harbor.

The cost was estimated to be $69,025.

The project was modified in 1874 so as to include the removal of rocks in and near the draw of the bridge at Deer Island, 2 miles above Newburyport, and at Rocks bridge, and at Little Curriers Shoal, East Haverhill, so that the channel should have the following depths at ordinary high-water stages of the river: From the mouth to Deer Island bridge, 5 miles, 16½ feet; thence to Haverhill bridge, 12½ miles, 12 feet; thence to the foot of Mitchells Falls, Hazeltine Rapids, 1½ miles, 10 feet; thence through Mitchells Falls to the head of the Upper Falls, 2½ miles, not less than 4½ feet, when the mill water at Lawrence is running.

This revised project was estimated to cost $147,000.

The total appropriations to date are $242,366.72.

The expenditures to June 30, 1893, were $233,275.20.

The excess of expenditure over the estimate is due to the removal of rocks and other obstructions that were unknown and removal not contemplated when the estimate was made, and by the expense of necessary surveys and examinations not provided for in the estimate.

The condition of the improvement on June 30, 1893, was as follows:

The modified project of 1874 was completed with the exception of the removal of the "Boilers" upon which work was in progress under a contract with Messrs. Sturgis & Andrews, of Bonny Eagle, Me.

This contract was completed in August, 1893; 350 cubic yards of ledge were removed.

At the date of this report the project for the improvement of the river is completed, and the improved channel is in good order.

To extend the improvement so that the same depth of water as is now obtained through Mitchells Falls can be carried to Lawrence (a distance of 5 miles from the head of the falls), was in 1882 estimated to cost, for dredging through Gages Shoal and Andover Bar and removing bowlders and ledges, $11,000.

This work is located in the collection district of Newburyport, Mass., of which Newburyport is the nearest port of entry. The nearest light-houses are the Plum Island lights and the Newburyport Upper Harbor lights.

Commercial statistics are included in statement for Newburyport Harbor.

No increase of the tonnage of the river is apparent since the improvement was commenced, and no new lines of water transportation have been established.

The dates and amounts of appropriations for this work are as follows:

Act of—		Act of—	
May 23, 1828	$32,100.00	June 18, 1878	$10,000.00
April 2, 1830	3,506.72	March 3, 1879	5,000.00
March 2, 1831	16,000.00	June 14, 1880	12,000.00
March 2, 1833	4,900.00	March 3, 1881	9,000.00
June 28, 1834	3,860.00	August 2, 1882	9,000.00
July 11, 1870	25,000.00	July 5, 1884	3,500.00
March 3, 1871	25,000.00	September 19, 1890	10,000.00
June 10, 1872	25,000.00	July 13, 1892	1,500.00
March 3, 1873	25,000.00		
June 23, 1874	10,000.00	Total	242,366.72
March 3, 1875	12,000.00		

Appropriations made since 1870 have been expended on the approved project of that date and its modifications.

Money statement.

July 1, 1893, balance unexpended	$9,091.52
June 30, 1894, amount expended during fiscal year	3,779.80
July 1, 1894, balance unexpended	5,311.72

B 3.

IMPROVEMENT OF POWOW RIVER, MASSACHUSETTS.

Powow River is a tributary of the Merrimac River, which it joins from the north about 3½ miles above Newburyport.

The tide enters the river a distance of about 9,600 feet, following the channel, or to a dam just above the town of Amesbury, Mass.

The present channel is narrow, exceedingly crooked, and is not navigable at low water. The mean range of the tide at the mouth of the river is 6.7 feet.

The project for the improvement of the river was proposed January 24, 1885. It was based on the survey provided for in the act of July 5, 1884.

This project proposed to make a channel 9,600 feet long, 60 feet wide on the bottom, and 12 feet deep at mean high water, at an estimated cost of $77,000.

Three appropriations have been made for this improvement, viz, by the act of August 11, 1888, which appropriated $3,000 for dredging, provided that this sum shall not be expended until the towns of Amesbury and Salisbury, or either of them, shall have caused such a draw to be placed in the present bridge over said river as may be approved by the Secretary of War; by the act of September 19, 1890, $5,000, with a similar proviso; and by act of July 13, 1892, $4,000.

On April 10, 1889, the Secretary of War approved the plan of the proposed bridge. On May 11, 1892, the chairman of the selectmen of the town of Amesbury, Mass., stated that the bridge over the Powow River had been reconstructed in accordance with the approved plans.

The available funds are insufficient to afford any appreciable benefit to commerce by their expenditure, and they will be retained in the Treasury until additional funds are provided.

To complete this improvement will require an appropriation of $65,000. Of this amount $30,000 could be expended to advantage during the fiscal year ending June 30, 1896.

This work is located in the collection district of Newburyport, Mass., of which Newburyport is the nearest port of entry. The nearest light-houses are the Newburyport Upper Harbor lights.

No increase in the tonnage of the river is apparent, and no new lines of water transportation have been established.

Commercial statistics are included in the statement for Newburyport Harbor.

Money statement.

July 1, 1893, balance unexpended	$12,000.00
July 1, 1894, balance unexpended	12,000.00
Amount (estimated) required for completion of existing project	65,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	30,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

B 4.

IMPROVEMENT OF IPSWICH RIVER, MASSACHUSETTS.

Ipswich River empties into Plum Island Sound 9 miles south of Newburyport, Mass., and at the same distance west of Cape Ann. The head of navigation is 3 miles above the mouth.

The entrance of Plum Island Sound is 7 miles east of the mouth of the river. Six feet depth at mean low water can be carried over the bar at the entrance to the sound, and between the bar and the mouth of the river there is a good anchorage, with from 3 to 5 fathoms of water.

Before improvement the channel of the river from its mouth to Barras Turn, a distance of 2 miles, was at least 60 feet wide and 4 feet deep at mean low water. From Barras Turn to the town wharves, a distance of 1 mile, the channel was narrow and crooked, and had at some places but 1½ feet depth at mean low water. The rise or fall of the tide is 8.4 feet.

The original project for improvement was submitted December 6, 1875. It proposed a channel 60 feet wide and 4 feet deep at mean low water from Barras Turn to the town wharves, at an estimated cost of $25,000.

On November 5, 1883, the project was divided into three partial projects:

1. The removal of the ledges at Heards Point and opposite Nabbys Point to a depth of 2 feet at mean low water, to open a navigable channel of that depth, at a cost of $15,900.

2. To dredge the shoals at Labor in Vain and The Shoals so as to open a channel 4 feet deep at mean low water and 60 feet wide, at a cost of $2,200.

3. To straighten the channel by making a cut across Barras Turn and to build a jetty to close the old channel, at a cost of $6,900.

In the Annual Report of 1887, it was recommended that the general project be modified by limiting the present improvement to opening a channel 60 feet wide and 4 feet deep through The Shoals and Labor in Vain, and extending it to the deep hole opposite the town wharves.

A chart showing this limited project was published in the Report of the Chief of Engineers for 1887.

The amount which has been appropriated for this work to date is $7,500.

The amount expended to June 30, 1893, was $2,556.29.

On June 30, 1893, a channel had been dredged 4 feet deep at mean low water, 60 feet wide at Labor in Vain, and 40 feet wide at The Shoals; and a contract was in force with Mr. Edgar P. Lovering, of South Boston, Mass., to remove 6,000 cubic yards by dredging, and thus complete the limited project.

Operations under this contract were commenced during the latter part of June, 1894, and as but 1,506 cubic yards were dredged during the fiscal year, the condition of the improvement at the date of this report is essentially the same as on June 30, 1893.

To complete the original project would require an appropriation of $17,500, but the present proposed partial project, it is believed, will fully meet all the reasonable demands of the commerce of the river, and the available funds will suffice for this purpose.

Ipswich River is in the collection district of Newburyport, Mass. The nearest light-house is the Ipswich Light on Castle Neck, about 1½ miles southeast from the mouth of the river.

Commercial statistics are included in the statement for Newburyport Harbor.

No increase in the tonnage of the river is apparent and no new lines of water transportation have been established.

The dates and amounts of appropriations for this work are:

By act of—	
August 5, 1886	$2,500
August 11, 1888	2,500
July 13, 1892	2,500
Total	7,500

Money statement.

July 1, 1893, balance unexpended		$4,943.71
June 30, 1894, amount expended during fiscal year		81.30
July 1, 1894, balance unexpended		4,862.41
July 1, 1894, outstanding liabilities	$527.10	
July 1, 1894, amount covered by uncompleted contracts	1,572.90	
		2,100.00
July 1, 1894, balance available		2,762.41

B 5.

IMPROVEMENT OF ESSEX RIVER, MASSACHUSETTS.

Essex River winds between marshy banks for 3½ miles from the head of navigation, at the village of Essex, to its mouth, which forms a harbor of refuge for light-draft vessels, about 3 miles to the southeastward of the entrance to Ipswich River, Massachusetts.

The channel of the river is crooked and obstructed by sand bars and bowlders.

The project for its improvement was submitted May 15, 1891. It proposed to widen and deepen the upper 12,000 feet of the natural channel of the river, so that 4 feet at mean low water could be carried to the head of navigation in a channel 60 feet wide at a cost, as estimated, of $25,000.

But one appropriation has been made for this work, viz, by the act of July 13, 1892, $5,000.

The available funds are insufficient to afford any appreciable benefit to commerce by their expenditure, and they will be retained in the Treasury until additional funds are provided.

No operations were in progress during the year, and at the date of this report the original condition of the river is unaltered.

To complete the improvement will require an appropriation of $20,000, all of which could be expended to advantage during the fiscal year ending June 30, 1896.

Essex River is in the collection district of Gloucester, Mass., of which Gloucester is the port of entry. The nearest light-house is Annisquam Light, 2 miles east of the mouth of the river.

Commercial statistics are included in the statement for Gloucester Harbor, Masschusetts.

Money statement.

July 1, 1893, balance unexpended	$5,000.00
July 1, 1894, balance unexpended	5,000.00
Amount (estimated) required for completion of existing project	20,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	20,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

B 6.

HARBOR OF REFUGE, SANDY BAY, CAPE ANN, MASSACHUSETTS.

Sandy Bay is situated at the northeastern extremity of the promontory of Cape Ann, which forms the northern limit of Massachusetts Bay. Its shore lines form a little less than a right angle, and their directions are nearly north and south and east and west. The rocky island of Straitsmouth forms the eastern extremity of one shore line, and the steep headland of Andrews Point the northern end of the other. Following the line of the proposed breakwater the bay is 2¾ miles wide, and has a depth of 2 miles, approximately.

The bay on the land side is perfectly protected by steep, high hills, but it fronts the northeast and is open to the full force of the violent northerly and easterly gales of this coast.

The great seas of the ocean are broken, however, in a degree by the sunken rocky ledges called Averys Ledge, the Dry and Little Salvages, the Flat Ground, and Abners Ledge, which are directly at the mouth of the bay. Inside these entrance ledges the bay is entirely unobstructed, and has an average depth of 50 feet at mean low water.

A plan of the bay showing the proposed breakwater was published in the Annual Report of the Chief of Engineers for 1892, p. 564.

The original project for improvement was submitted in 1884. It proposed a continuous breakwater 9,000 feet long, divided into two branches; one starts at Averys Ledge and runs in a direction a little west of north to Abners Ledge, a distance of 3,600 feet; the other extends 5,420 feet from Abners Ledge in a northwesterly direction and terminates at the 84-foot contour off Andrews Point.

The axis of the proposed breakwater is approximately at the inner edge of the ledges, at the entrance of the bay, and about 1 mile inside the Salvages and Flat Ground, which receive the first shock of easterly storm waves. .

The southern entrance to the proposed harbor lies between Straitsmouth Island and Averys Ledge, and is to be 1,800 feet wide and at least 30 feet deep. The northern entrance near Andrews Point is 2,700 feet wide and 80 feet deep. They are so located with reference to each other that vessels can enter and leave the harbor with any wind.

The harbor formed by the breakwater covers an anchorage of 1,377 acres, in which the depth exceeds 24 feet at mean low tide.

The original project proposed to build the substructure of the breakwater to the level of 22 feet below mean low water of a mound of rubblestone, 40 feet wide on top.

On March 2, 1892, the project was modified to include the entire breakwater by a report of the special board of engineers constituted for that purpose.

This project was approved March 17, 1892, and it proposes to construct the entire breakwater of rubblestone with the following section: On the sea side, from the bottom to 15 feet below mean low water, a slope of 1 on $1\frac{1}{2}$; thence to mean low water, 1 on 3; thence to 18 feet above mean low water, 1 on 1; the width on the crest, 20 feet; and the rear slope, 1 on $\frac{72}{100}$ to mean low water; thence to the bottom, 1 on 1.

The axis of the eastern branch of the breakwater is indicated by an iron spindle on Averys Ledge when in range with the south light-house on Thatchers Island. Cross ranges are established by iron pipes let into the rocks on Dry and Little Salvages, which mark points at intervals of 100 feet from the spindle (initial point) on Averys Ledge. The axis of the north branch is cross range 3640.

The estimated cost of the improvement is $5,000,000, to which must be added $2,500,000 for buoyage, lighting, and defense of the harbor.

These estimates are based upon consecutive annual appropriations of not less than 10 per cent of the original estimates of cost. Should operations be suspended at any time from want of funds, or annual appropriations be reduced to small sums for a series of years, the expense for the final construction will be proportionally increased.

The total appropriations to date are $600,000.

The expenditures, not including outstanding liabilities, to June 30, 1893, were $476,485.08.

On June 30, 1893, 591,797 tons of stone had been deposited in the breakwater. Of this amount 591,073 tons were small stone (less than 4 tons weight) deposited below low water, and 724 tons were large stone (averaging 6 tons weight) and deposited above low water. Four thousand six hundred feet of the breakwater, between cross ranges 140 and 4740, were to a grade 22 feet below mean low water; 200 feet, between cross ranges 3640 and 3440, were to the grade of mean low water, and 50 feet of the breakwater, between cross ranges 3540 and 3490, were completed.

Operations were in progress under a contract with the Rockport and Pigeon Hill Granite companies to deposit 14,000 tons of large stone and 120,000 tons of small stone in the breakwater.

During the fiscal year 70,755 tons of small stone and 9,224 tons of large stone were deposited between cross ranges 3640 and 2940; the breakwater was completed between cross ranges 3540 and 3040 and brought to the grade of mean low water between 3640 and 2940.

Two hundred feet of the breakwater were completed at the close of the working season 1893 and exposed to the unusually severe storms of the winter 1893-'94. The only effect noticed as produced by these storms was a settling of the large stone an average of 2 feet on the southern half of the completed portion of the breakwater. This would seem to indicate that one or more seasons should be allowed to elapse after the breakwater is brought to the grade of mean low water before the large stone forming the superstructure are put in place.

The total number of tons of stone placed in the breakwater to date is 671,776 tons, of which 9,948 tons were large and 661,828 tons small.

To complete the project will cost $4,400,000.

During the fiscal year ending June 30, 1896, $500,000 could be expended to advantage.

The prospective benefits to commerce and navigation by the construction of this harbor of refuge are increased safety to life and property and a consequent reduction in freight and insurance.

Sandy Bay is situated in the collection district of Gloucester, Mass., of which Gloucester is the port of entry. The nearest light-house is Straitsmouth Light, at the southern entrance of the bay.

The accompanying commercial statistics for the fiscal year ending June 30, 1894, have been furnished by Mr. Charles S. Rogers, of Rockport, Mass.

The dates and amounts of the appropriations for this work are as follows:

Act of—	
July 5, 1884	$100,000
August 5, 1886	100,000
August 11, 1888	100,000
September 19, 1890	150,000
July 13, 1892	150,000
Total	600,000

Money statement.

July 1, 1893, balance unexpended		$123,514.92
June 30, 1894, amount expended during fiscal year		81,810.38
July 1, 1894, balance unexpended		41,704.54
July 1, 1894, outstanding liabilities	$20,769.34	
July 1, 1894, amount covered by uncompleted contracts	10,425.50	
		31,194.84
July 1, 1894, balance available		10,509.70
Amount (estimated) required for completion of existing project		4,400,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896		500,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

COMMERCIAL STATISTICS.

Articles.	1892.	1893.	1894.
Shipped:			
Stone ....tons..	199,191	170,000	271,000
Received:			
Coal ....tons..	8,153	8,126	8,900
Wood ....cords..	160	490	200
Lumber ....feet..	300,000	250,000	325,000
Fish ....pounds..	3,115,000	2,340,000	2,900,000
Mackerel ....barrels..	1,000	....	900
Fish sounds ....pounds..	20,000	....	260,000
Lobsters ....barrels..	1,000	600	900
Cod oil ....gallons..	8,000	7,200	9,000
Medicine oil ....do....	4,000	4,700	4,500
Salt ....hogsheads..	1,200	1,000	600

B 7.

IMPROVEMENT OF HARBOR AT GLOUCESTER, MASSACHUSETTS.

This is the most important harbor between Boston and Portland, and is the principal resort for all New England fishing vessels. It is situated at the southeastern extremity of Cape Ann, 20 miles northeast from Boston. It is easily entered when the dangerous storms of this coast occur, and provides a secure, ample shelter for all classes of vessels, except from south winds, and from these a moderate extent of protected anchorage is afforded in the inner harbor.

It contains in the outer roadstead, the inner harbor, and in the inner channel connecting them sufficient deep water for the most liberal demands of commerce, but the inner harbor and channel are obstructed by bowlders, ledges, and shoals dangerous and inconvenient to shipping, and the outer harbor or roadstead is open to the action of all southerly winds.

A plan of the harbor was published in the Annual Report of the Chief of Engineers for 1887, p. 506.

The first project formed for improvement was submitted January 20, 1871, and was based on the survey provided for by the act of July 11, 1870. (Report of Chief of Engineers, 1871, p. 869.) This project proposed the removal of certain bowlders from the inner harbor at a cost, as estimated, of $10,606.20, and the construction of a breakwater from Eastern Point over Dog Bar to Round Rock Shoal, at an estimated cost of $494,148.65.

On November 10, 1884, Maj. C. W. Raymond, Corps of Engineers, by order of the special board of engineers that was considering the subject of the Sandy Bay Breakwater, submitted a project for two breakwaters at the entrance of Gloucester Harbor, one to cost $752,000 on essentially the same site as that proposed in 1871, and a supplementary one through Normans Woe Rock to cost $607,000.

This project and estimate are published in the Chief of Engineers' Report for 1885, p. 534.

On January 20, 1885, it was recommended, in accordance with act of July 5, 1884, that a survey of the inner harbor and of the reef off Muscle Point be made, and that Babson Ledge be removed to 21 feet at mean low water. (Report of Chief of Engineers, 1885, p. 541.) In the annual report for this harbor for 1887 a general project for its improvement was submitted, based on the survey provided for by the act approved August 5,

1886. (Chief of Engineers' Report, 1887, p. 500.) This project proposed to remove from the inner harbor 101½ cubic yards of rock known to exist, and to dredge 216,000 cubic yards, scow measurement, at an estimated cost of $65,000; and to construct the breakwater recommended in the project of 1884, that extends from Eastern Point to Round Rock Shoal, at an estimated cost of $752,000.

The total appropriations to date are $80,000.

The expenditures to June 30, 1893, were $36,721.50.

The condition of the improvement on June 30, 1893, was as follows: Clam Rock had been reduced from 1 foot to 9½ feet at mean low water; Pinnacle Rock from 8½ to 16½ feet, mean low water; rock off Pew's Wharf from 2 to 5 feet, mean low water; rocks off J. Friend's Wharf from 13 to 17 feet, mean low water. All of the above rocks were reduced to the level of the surrounding bottom. Babsons Ledge had been reduced from 11 to 14 feet, mean low water.

No work had been done on the breakwater. Two channels had been dredged in Harbor Cove, approximately parallel to the heads of the wharves; the east channel was 550 feet long; the west, 1,000 feet long; both were 140 feet wide, 10 feet deep at mean low water, except over a small ledge uncovered by the dredging off Parmenter's Wharf. The main harbor had been improved as projected from its entrance near Fort Point to the steamboat wharf, so that 15 feet depth at mean low water could be carried, except over 4 small ledges uncovered by the dredging near the Halibut Company Wharf.

On June 30, 1893, operations were in progress under a contract with the National Dredging Company, of Wilmington, Del.

Work under this contract was continued until the latter part of September, 1893, when all of the dredging proposed by the project was completed.

The ledges uncovered by the dredging were surveyed and were found to contain 549 cubic yards above the grade of the projected improvement.

On January 22, 1894, sealed proposals were invited by public advertisement for the removal of these ledges. An abstract of the bids received will be found in the annexed table.

On March 6, 1894, a contract was entered into with Messrs. Townsend & Johnston, of Somers Point, N. J., to remove 549 cubic yards of ledge, at $9.86 per cubic yard.

Operations under this contract were commenced in April, 1894, and at the close of the fiscal year 386 cubic yards had been removed.

At the date of this report all of the proposed dredging has been done, and the removal of the ledges uncovered by this dredging is under way. Nothing has been done on the breakwater.

To complete the improvement will require an appropriation of $752,000, of which $250,000 could be expended to advantage during the year ending June 30, 1896.

The prospective advantages to commerce by the completion of the improvement are a more safe anchorage for vessels seeking protection from southerly gales.

Gloucester Harbor is in the collection district of Gloucester, Mass., of which Gloucester is the port of entry.

The nearest light-houses are Ten Pound Island Light, in the harbor, and Eastern Point Light, at its entrance.

The accompanying commercial statistics for the fiscal year have been furnished by the collector of customs at Gloucester, Mass.

The dates and amounts of the appropriations for this work are as follows:

Act of—	
June 10, 1872	$10,000
August 5, 1886	5,000
August 11, 1888	10,000
September 19, 1890	15,000
July 13, 1892	40,000
Total	80,000

Money statement.

July 1, 1893, balance unexpended		$43,278.50
June 30, 1894, amount expended during fiscal year		22,921.63
July 1, 1894, balance unexpended		20,356.87
July 1, 1894, outstanding liabilities	$2,297.38	
July 1, 1894, amount covered by uncompleted contracts	1,607.18	
		3,904.56
July 1, 1894, balance available		16,452.31
Amount (estimated) required for completion of existing project		752,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896		250,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

Abstract of proposals for removal of ledges from Gloucester Harbor, Massachusetts, opened February 23, 1894, by Lieut. Col. S. M. Mansfield, Corps of Engineers.

No.	Name and address of bidder.	Price bid per cubic yard, measured *in situ*.	Total.	Remarks.
1	Geo. W. Townsend, Boston, Mass	$15.94	$8,751.36	
2	Herbert H. Sturgis, Bonny Eagle, Me.; Solon S. Andrews, Gorham, Me., and Thos. Liddle, East Boston, Mass.	12.45	6,835.00	
3	Hiram W. Phillips, Quincy Point, Mass	21.45	11,226.05	
4	Enoch Townsend and Chas. W. Johnston, Somers Point, N. J.	9.86	5,413.14	Lowest bid.
5	Robert H. Rogers and John J. Fitzpatrick, Plattsburg, N. Y.	12.80	7,027.20	
6	John Austin, Philadelphia, Pa	14.37	7,889.13	
7	Thomas Symonds, Manchester, Mass	17.50	9,607.50	

The contract was awarded to Messrs. Townsend and Johnston, with the approval of the Chief of Engineers.

COMMERCIAL STATISTICS.

Amount of revenue collected, 1892, ——; 1893, $9,083; 1894, $4,204.

Shipping.	1892.		1893.		1894.	
	No.	*Tons.*	*No.*	*Tons.*	*No.*	*Tons.*
Entrances:						
Foreign	213	43,460	153	22,135	153	22,140
Domestic	25	2,700	9	1,490	29	3,522
Clearances:						
Foreign	189	25,700	145	18,021	143	18,169
Domestic	77	17,110	63	9,734	69	12,243

COMMERCIAL STATISTICS—continued.

Imported.	1892.	1893.	1894.
	Tons.	*Tons.*	*Tons.*
Coal	37,200	* 30,000	52,000
Iron			200
Salt	33,000	16,000	26,595
Lumber	200	† 288,000	100
Miscellaneous	8,500	500	2,500

* From coastwise ports.

† Feet.

All classes of vessels frequent the harbor, from 5 to 1,500 tons. Greatest draft 24 feet.

B 8.

IMPROVEMENT OF HARBOR AT MANCHESTER, MASSACHUSETTS.

Manchester Harbor is situated about 5½ miles northeastward from the entrance of Salem Harbor, Massachusetts.

A chart of the harbor was published in the Annual Report of the Chief of Engineers for 1888, part 1, p. 466.

The outer sheltered roadstead contains approximately 300 acres, with 5 fathoms of water.

The entrance channel from the roadstead to Proctors Point is everywhere at least 100 feet wide, and 6½ feet deep at mean low water, and is unobstructed.

At the Narrows, distant 1,400 feet inside of Proctors Point, the depth in the channel was reduced to 1½ feet at mean low water; thence to the town wharves, a farther distance of 2,500 feet, no low-water channel originally existed. Near the town wharves the channel is crossed by the Boston and Maine Railroad (eastern division) on a bridge which has a draw opening 28 feet wide.

The original project for the improvement of this harbor was submitted November 28, 1887. It was based on a survey provided for in the river and harbor act of August 5, 1886. It proposed to dredge a channel 60 feet wide, 4,000 feet long, and 4 feet deep at mean low water from Proctor's Point to the town wharves, at an estimated cost of $14,300.

The total appropriations for this improvement to date have been:

By the act of—	
August 11, 1888	$2,500
September 19, 1890	5,000
July 13, 1892	6,800
Total	14,800

The expenditures to June 30, 1893, were $7,155.93, and the improved channel was 35 feet wide, 4 feet deep at mean low water from Proctors Point to the railroad bridge, a distance of 2,900 feet. A contract dated September 17, 1892, was in force with Mr. Edgar P. Lovering, of South Boston, Mass., to dredge 22,222 cubic yards, and thus complete the improvement.

Operations under this contract were commenced in October, 1893, and were satisfactorily completed in April, 1894.

At the date of this report the improved channel is 60 feet wide and 4 feet deep at mean low water from Proctors Point to the town wharf; opposite the town wharf it is 80 feet wide.

Manchester Harbor is in the collection district of Gloucester, Mass., of which Gloucester is the port of entry; the nearest light-house is on Bakers Island, 2¼ miles from Proctors Point.

The existing commerce is nominal, and commercial statistics are included in the statement for Gloucester Harbor, Massachusetts.

Money statement.

July 1, 1893, balance unexpended	$7,144.07
June 30, 1894, amount expended during fiscal year	6,483.36
July 1, 1894, balance unexpended	660.71

B 9.

IMPROVEMENT OF HARBOR AT SALEM, MASSACHUSETTS.

Salem Harbor is 12 miles to the northward of Boston, Mass. Fort Pickering Light marks its entrance between Winter Island on the west and Naugus Head on the east. The harbor is 1,750 feet wide at its entrance and 5,500 feet long between the 12-foot contours of opposite shores. It contains a well-sheltered, entirely unobstructed anchorage of about 110 acres of a greater depth than 18 feet mean low water. In front of the city are extensive flats, which make long wharves necessary to reach deep water. The principal wharves of the city are located on "South River," a small stream which formerly drained a tidal basin on the southwestern side of the city. This basin is now practically filled up by city improvements. The river is 3,000 feet long to the head of navigation at South or Lafayette Street bridge. It is crossed by a highway bridge about one-fourth of a mile below the head of navigation, with a draw-opening 31½ feet wide. The width of the river varies from 300 feet at its mouth to 150 feet at the head of navigation.

Originally the greatest depth of continuous low-water channel was 0.8 feet.

The original project for the improvement of the harbor was submitted December 16, 1872. It was proposed to dredge a channel 1,730 feet long, 300 feet wide, 8 feet deep at mean low water, at an estimated cost of $32,000. This project was essentially completed 1873–'75.

The present project for the improvement of the harbor was submitted December 2, 1889. It was based on a survey provided for in the act of August 11, 1888. It proposed as follows:

To clean out the channel of approach to South River to the original dimensions as dredged in 1873–'75, viz, 300 feet wide at the entrance and 150 feet wide off Derby Wharf Light, 8 feet deep at mean low water; to extend this channel with the same depth, gradually reducing the width to 100 feet to near the inner end of Derby Wharf; and from this point to the head of navigation to excavate a channel 50 feet wide and 6 feet deep at mean low water.

The total length of channel to be improved was 5,100 feet approximately, and its excavation would require the removal of 85,000 cubic yards of material, at an estimated cost of $28,000.

The total appropriations to date have been $53,000.

The expenditures to June 30, 1893, were $37,801.20.

On June 30, 1893, the improved channel was 50 feet wide, 8 feet deep to near the inner end of Derby Wharf, and thence to the head of navigation 6 feet deep at mean low water; and a contract was in force with

Mr. Augustus R. Wright, of Portland, Me., dated September 17, 1892, to remove by dredging 40,000 cubic yards and thus complete the project.

Operations under this contract were commenced in April, 1894, and it was satisfactorily completed in June, 1894. Fifty-four thousand six hundred and fifty-two cubic yards were dredged under it, and at the date of this report the project for the improvement of the harbor is completed.

Salem Harbor, including South River, Massachusesti, is in the collection district of Salem, Mass., of which Salem is the port of entry. The nearest light-house is Derby Wharf Light, Salem Harbor, Massachusetts.

The accompanying commercial statistics for the fiscal year ending June 30, 1894, have been furnished by the collector of customs at Salem, Mass.

The dates and amounts of the appropriations for this improvement are as follows:

Act of—	
March 3, 1873	$15,000
June 23, 1874	10,000
September 19, 1890	14,000
July 13, 1892	14,000
Total	53,000

Money statement.

July 1, 1893, balance unexpended	$15,198.80
June 30, 1894, amount expended during fiscal year	2,437.59
July 1, 1894, balance unexpended	12,761.21
July 1, 1894, outstanding liabilities	9,122.44
July 1, 1894, balance available	3,638.77

COMMERCIAL STATISTICS.

Amount of revenue collected 1892, $3,611.62; 1893, $2,384.85; 1894, $2,171.18.

Shipping.	1892.		1893.		1894.	
	No.	*Tons.*	*No.*	*Tons.*	*No.*	*Tons.*
Entrances:						
Foreign	77	10,720	74	11,536	80	11,334
Domestic	10	2,356	2	148	13	2,308
Clearances:						
Foreign	75	11,123	......	6,820	55	10,915
Domestic	39	5,933	......	8,303	58	8,867

Imported.	1892.	1893.	1894.
Coal ... tons	3,256	356,824	403,104
Lumber ... feet	875,791	3,805,944	4,720,280
Shingles ... number	3,323,000	2,628,000	2,014,000
Laths ... do	575,000	1,774,000	822,200
Eggs ... dozen	1,074	....	....
Firewood and bark ... cords	1,160	752	733
Lime and cement ... barrels	1,000	29,993	7,621
Railroad ties ... number	4,624	7,926	5,800
Bricks ... do	....	30,000	10,000
Stone ... tons	....	6,849	3,512
Clay ... do	....	405	60
Piling ... feet	....	46,500	17,492
Sand ... tons	....	5,904	6,194
Powder ... cases	....	80	861

Miscellaneous for 1894: Four hundred and forty-five bushels potatoes; salt, 2,880 bushels; hay, 137 tons; water pipe, 24 pieces; gas pipe, 243 tons.

Vessels of all descriptions drawing from 9 to 21 feet frequent the harbor.

B 10.

IMPROVEMENT OF HARBOR AT LYNN, MASSACHUSETTS.

Lynn Harbor is situated 9 miles northeast from Boston. It is approximately 1 by 2 miles in extent, of which the greater part is dry at low tide.

It is protected on the north and west by the mainland, on the east by Nahant Beach, and its entrance, 2 miles wide, into Massachusetts Bay, is on the south side.

A plan of the harbor, showing the projected improvement, was published in the Annual Report of the Chief of Engineers for 1884, part 1, p. 532.

Before improvement three narrow and crooked channels of approach to the wharves existed, in each of which there was about 6 feet depth at mean low water. The mean rise or fall of the tide is 9.3 feet.

The western channel leads to the Point of Pines and the mouth of the Saugus River. The main ship channel is entered between White and Lobster rocks, and connects about 3,600 feet northward with the Black Rock Channel, which is the most eastern, near Nahant Beach.

The project for improvement was adopted in 1884. It provides for the excavation of a channel 200 feet wide and 10 feet deep at mean low water, from a point near and east of the White Rocks, to deep water opposite Little Nahant, a distance of 3,610 feet. This is called the outer improved channel, and is merely a rectification and deepening of the main ship channel. The combined main ship channel and Black Rock channel are sufficient for the purposes of commerce for the next 2,500 feet. Then commences the inner improved channel, which is projected 6,450 feet long, 200 feet wide, and 10 feet deep at mean low water. It extends from deep water, opposite Sand Point, to the harbor commissioners' line, and follows very closely in direction the extension of the main ship and Black Rock channels.

On September 24, 1888, this project was modified. It was then proposed to extend the main ship channel 400 feet within the harbor line, and to excavate at its inner end a basin 500 by 300 feet in area, 10 feet deep at mean low water.

It is supposed that the inner channel will need to be dredged occasionally to maintain its width and depth, but a training wall about 6,000 feet long is proposed to aid in keeping the outer channel open, if experience shall show it to be necessary. This wall is to start from the shore at "Little Nahant" and is to cross Black Rock channel. Its outer portion is to be parallel to the outer improved channel.

The cost of the original project was estimated to be $145,000. This estimate was revised in 1885, and then made $157,000, to provide for an increased amount of dredging found to be necessary during the progress of the work, to round off the junctions of the natural channel with the dredged channel, to provide flatter slopes to the sides of the cuts than was originally designed, and also to provide funds for necessary surveys during the progress of the work.

The modifications proposed September 24, 1888, were estimated to cost $25,000, which would make the total cost of the improvement $182,000.

The total appropriations for this work have been $101,000.

The amount expended to June 30, 1893, was $85,752.41.

On June 30, 1893, the outer channel and the basin were completed as proposed; the inner channel was 150 feet wide, and operations were in progress under a contract with Messrs. Boynton Bros., of Boston, Mass., to dredge 40,000 cubic yards from the western and inner channels.

Operations under this contract were commenced in June, 1893, and finished in August, 1893; 39,808 cubic yards were dredged under the contract, of which 18,377 were removed from the western channel and the balance from the inner channel.

During the month of July, 1893, a survey of the outer improved channel was made, and no essential change in its condition was found.

At the date of this report the outer channel is completed; the inner channel is completed for 500 feet at the southerly end, the balance is 150 feet wide; the basin is completed; the western or Saugus River channel is 4,000 feet long, 150 feet wide, 8 feet deep at mean low water.

To complete this improvement will require an appropriation of $81,000, of which $20,000 could be expended to advantage during the fiscal year ending June 30, 1896, in completing the proposed dredging.

Lynn is a port of entry in the collection district of Marblehead, Mass. The nearest light-house is Egg Rock (Nahant) Light, 3 miles distant.

The accompanying commercial statistics for the fiscal year ending June 30, 1894, have been furnished by the collector of customs at Marblehead, Mass.

The date and amount of appropriations for this work are as follows:

Act of—	
August 2, 1882	$60,000
August 5, 1886	6,000
August 11, 1888	10,000
September 19, 1890	15,000
July 13, 1892	10,000
Total	101,000

Money statement.

July 1, 1893, balance unexpended	$15,247.59
June 30, 1894, amount expended during fiscal year	14,362.84
July 1, 1894, balance unexpended	884.75
Amount (estimated) required for completion of existing project	81,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	20,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

COMMERCIAL STATISTICS.

Amount of revenue collected, 1892, $3,545.17; 1893, $4,755.48; 1894, $3,124.31.

Shipping.	1892.		1893.		1894.	
	No.	*Tons.*	*No.*	*Tons.*	*No.*	*Tons.*
Entrances:						
Foreign	33	2,760	42	4,030	27	2,519
Domestic	734	150,000	1,207	245,213	639	251,000
Clearances:						
Foreign	31	3,790	48	5,348	32	3,406
Domestic	736	146,000	1,207	245,213	639	251,006

Imported.	1892.	1893.	1894.
	Tons.	*Tons.*	*Tons.*
Coal	148,577	139,102	119,965
Iron	1,447	485	1.140
Lumber	*10,326,000	*5,911.000	*3,523,000
Merchandise		†2,540,000	‡11,500
Miscellaneous	25,000	21,000	‡14,590

* Feet. † Shingles, laths, etc. ‡ Exported.

All classes of vessels frequent the harbor, drawing from 8 to 18 feet of water.

B 11.

IMPROVEMENT OF HARBOR AT WINTHROP, MASSACHUSETTS.

This harbor is situated in the northeastern part of Boston Harbor, immediately westward of Winthrop Head.

A chart of the harbor was published in the Annual Report of the Chief of Engineers for the year 1888, part 1, p. 470.

The harbor contains, approximately, 350 acres, all of which is dry at low tide except a short, narrow, crooked slough east of Snake Island. The mean range of the tide is 9.4 feet.

The nearest deep-water channel of Boston Harbor is known as the "Back" Channel, and it extends from Point Shirley to East Boston. It has from 9 to 16 feet depth at low tide. The town wharf is distant 3,900 feet from this "Back" Channel.

The original project for the improvement of this harbor was submitted November 28, 1887. It was based on the survey provided for in the act of August 5, 1886.

The project proposed to excavate a straight channel 3,900 feet long, 50 feet wide, and 6 feet deep at mean low water, from the "Back" Channel to Rice's Wharf, at an estimated cost of $17,600.

For this improvement the following appropriations have been made:

By act of—	
August 11, 1888	$1,000
September 19, 1890	5,000
July 13, 1892	3,000
Total	9,000

The amount expended to June 30, 1893, was $8,974.85, and the proposed improvement had been completed.

No operations were in progress during the year, and at the date of this report the improved channel is in good order.

Winthrop Harbor is in the collection district of Boston, Mass., of which Boston is the port of entry. The nearest light-house is at Deer Island Point.

Commercial statistics are included in the statement for Boston Harbor.

Money statement.

July 1, 1893, balance unexpended	$25.15
June 30, 1894, amount expended during fiscal year	8.36
June 1, 1894, balance unexpended	16.79

B 12.

IMPROVEMENT OF MYSTIC AND MALDEN RIVERS, MASSACHUSETTS.

These two rivers empty into the inner harbor of Boston, Mass.

The main river (Mystic) extends from the navy-yard to the town of Medford, a distance of about 4½ miles. Malden River is about 2 miles long, from the town of Malden to its junction with Mystic River, about 3 miles above the navy-yard.

Originally Mystic River had no navigable low-water channel. A project for its improvement was submitted May 9, 1891. It proposed to widen and deepen the natural channel of the river so that it should be 100 feet wide and 6 feet deep at mean low water to the first turn above Denning's Wharf, and thence to the head of navigation 4 feet deep, with the width gradually reduced to 50 feet at Craddock's bridge. The cost of this improvement was estimated to be $25,000.

Originally in Malden River there was in a narrow and exceedingly crooked channel a navigable depth of barely 7 feet at mean high water. The rise of the tide is 9.8 feet. The original project for its improvement was proposed December 1, 1880. It contemplated the excavation of a channel 100 feet wide and 12 feet deep at mean high water up to the second drawbridge, with two cutoffs, one east of the island near the junction of the Malden and Mystic rivers and the other through the marsh land, about half a mile above, at a cost of $35,000.

This project was modified in 1882. It was then proposed to make the natural channel 100 feet wide and 12 feet deep at mean high water to the first bridge, and thence 75 feet wide to the second bridge, at an estimated cost of $40,000.

Ten thousand dollars were appropriated for this work by the act of August 2, 1882, and expended (1883-'84) in making the channel from the mouth to the drawbridge in Malden, a distance of 1¼ miles, at least 50 feet wide (70 feet at turns), 12 feet deep at mean high water.

By the act of July 13, 1892, $10,000 were appropriated for the improvement of Mystic and Malden rivers.

On July 18, 1892, it was recommended that one-half of this amount be retained in the Treasury for the improvement of Malden River (when additional funds are available), and that the balance be expended in improving Mystic River as proposed from its mouth to Denning's Wharf.

On August 8, 1892, an advertisement was issued calling for proposals for this work. The lowest bid received (48 cents per cubic yard) was deemed excessive, and it was rejected.

No operations were in progress during the fiscal year, and at the date of this report the original condition of Mystic River is unaltered; and the improved channel of Malden River is at least 50 feet wide (70 feet at turns), 12 feet deep at mean high water, to the first bridge at Malden, a distance of 1¼ miles.

To complete the improvement of Mystic River would require an appropriation of $20,000 and of Malden River $30,000; a total of $50,000; all of which could be expended to advantage during the fiscal year ending June 30, 1896.

Mystic and Malden rivers are in the collection district of Boston, Mass., of which Boston is the port of entry. The nearest light-house is on Long Island, Boston Harbor, Mass.

The dates and amounts of appropriations for this work are as follows:

For Malden River, by act of August 2, 1882	$10,000
For Mystic and Malden rivers, by act of July 13, 1892	10,000

Money statement.

July 1, 1893, balance unexpended	$9,958.45
July 1, 1894, balance unexpended	9,958.45
Amount (estimated) required for completion of existing project	50,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	50,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

B 13.

IMPROVEMENT OF HARBOR AT BOSTON, MASSACHUSETTS.

Boston Harbor consists essentially of an inner and outer harbor, united by a deep waterway, and each accessible from the sea by a distinct channel, widening into a deep and spacious roadstead.

1. *Inner harbor.*—This harbor lies to the north and westward of Long Island, and has deep water and good anchorage in the President Roads, seaward of Lower Middle Bar, and also near the city, westward of Upper Middle Bar.

Four rivers discharge their waters into the basin, the Charles, Mystic, and Chelsea rivers from the north, and the Neponset from the south. The direct entrance from the sea is by Broad Sound.

2. *Outer harbor.*—This harbor lies to the southward of Long Island, and has a fine anchorage in Nantasket Roads, as well as in Hingham Bay, a well-sheltered harbor southeast of Paddocks Island. It connects with the inner harbor by the main ship channel through the "Narrows," and by secondary channels east and west of Long Island. It is reached from the sea by Nantasket Roads, which lie south of Georges and Great Brewster islands, and is marked at the sea entrance by Boston Light.

Weymouth and Weir rivers empty into the outer harbor.

Both the inner and outer harbors are subdivided into several minor harbors and contain many islands, which shelter the anchorages from winds and storm waves.

The range of tides at the navy-yard is 9.8 feet and at the entrance to the outer harbor 9.4 feet. A sketch of the harbor was printed in the Annual Report of the Chief of Engineers for the year 1888, page 454.

The object of the improvement is, first, to preserve the harbor by protecting the islands and headlands, and, second, to improve it by widening, deepening, and straightening the channels.

The works of preservation consist of sea walls, aprons, jetties, etc., which protect the shores of the islands and headlands, prevent additional wash into the channels, control the tidal scour, and preserve the full height of anchorage shelter for vessels in the roadsteads.

The works of improvement have been by dredging and blasting.

The total appropriations from 1825 to date have been $2,604,276.10.

The total expenditures to June 30, 1893 (excluding outstanding liabilities), were $2,264,863.80.

WORKS OF PRESERVATION.

Point Allerton.—This headland at the southeasterly entrance of the harbor is protected by a granite sea wall 1,202 feet in length, completed in 1873. Its concrete foundation for a distance of 1,005 feet is protected by an apron and eight short jetties of granite and rubblestone. No work was done on it during the fiscal year.

Its condition, June 30, 1894, is as follows:

The wall is generally in good order, although some of its joints need repointing. The bluff protected by this wall is not fully covered from storm action, and the sea wall should be extended westward for a distance of at least 150 feet, and the foundation of this extension should be protected with riprap.

This is estimated to cost $15,000.

Great Brewster Island.—This island is on the north side of the main ship channel near the entrance. It is protected by a granite sea wall

2,840 feet long, which was completed in 1869. No work was done on it during the fiscal year.

On June 30, 1894, the wall is in fair order, but some repointing is needed, for which funds are available.

Georges Island.—Its northern and eastern shores are protected by a granite sea wall 2,150 feet long. West of this wall is a riprap protection extending for 450 feet, and south of it another 600 feet long. The sea wall and southern riprap were built about 1835. The western riprap was built in 1884–'85.

No work was done on the wall or ripraps during the year, and they are in good order at the date of this report.

The unprotected western shore line of the island, in front of the Government buildings, has been considerably abraded, and it should be protected by a light sea wall, 1,400 feet long, at a cost of $35,000.

Lovells Island.—The western shore of this island is protected by a rubblestone apron 975 feet long, built in 1873, and repaired and extended in 1884; the northern shore is covered by a granite sea wall 750 feet long, built in 1843; and the eastern shore is protected by a granite sea wall 800 feet long, built in 1869 and repaired in 1879 and 1886, and by two rubblestone aprons, one between the northern and eastern sea walls, 1,440 feet long, and the other south of the east sea wall, 1,330 feet long.

No operations were in progress during the fiscal year.

The condition of the works on June 30, 1894, was as follows: The sea walls and the ripraps of the eastern shore were in good order; the western shore riprap was undermined in places and had fallen down, but it needed no immediate repairs.

Gallops Island.—The western, northern, and eastern shores of this island are protected by a granite sea wall 2,385 feet long, completed in 1892, and by a rubblestone apron, completed in 1884, 3,050 feet long, which also covers part of the foundation of the sea wall. No operations were in progress during the fiscal year, and at the date of this report the works are in good order.

Deer Island.—Three prominent bluffs of this island are protected by granite sea walls, originally built about 1827. The north head wall is 1,740 feet long, the middle head wall is 840 feet, and the south head wall is 380 feet long. In 1865 and 1869 these walls were partly rebuilt, and in the weakest places were backed with concrete. They were all originally built dry, and from time to time have required repairs.

No operations on these sea walls were in progress during the fiscal year, and they are in good order at the date of this report.

Long Island.—The north head of this island is protected by a granite sea wall 2,081¾ feet long, completed in 1874. Part of the foundation of the wall and the beach at both its ends is protected by a rubblestone apron, aggregating 1,675 feet in length. This apron was built in 1874, and extended in 1884 and 1892–'93.

No operations were in progress during the fiscal year, and the works are in good order at the date of this report.

Rainsford Island.—The north head of this island is protected by a dry granite sea wall 1,500 feet long, originally built about 1840, and extensively repaired in 1884–'85. No work was done during the fiscal year, and on June 30, 1894, the wall is in good order.

Castle Island.—The north and part of the east and west shores of this island are protected by a dry granite sea wall 3,300 feet long, built about 1835. A light riprap extends along the east shore 300 feet from the end of the wall; this was built in 1865. No work was done during the year ending June 30, 1894, and at that date the riprap was in good order. The sea wall needed repairs on the north face, a short distance west of the wharf, where the foundation has been undermined and the wall has settled. About 100 running feet of the wall has been thus injured, and this length of the wall needs taking down and rebuilding, at a cost of $1,000.

Governors Island.—The shore line of this island has never been protected. The east and south bluffs, however, should be covered by sea walls to prevent additional abrasion, not only to secure the sites of the batteries which occupy these bluffs, but also to prevent injury to the main ship channel.

The east bluff wall should be 500 feet long, and is estimated to cost $30,000; the south bluff wall should be 1,800 feet long, and will cost $50,000.

WORKS OF IMPROVEMENT.

The main ship channel.—Before improvement it had a least width of 100 feet and a least depth of 18 feet at mean low water. The original project for its improvement was submitted in 1867. It proposed to dredge the channel 23 feet deep at mean low water, 1,000 feet wide at the upper and lower middles, and 685 feet at the Narrows.

In 1870 the proposed width at the Narrows was reduced to 625 feet, and increased to 1,100 feet at the anchorage shoal in the inner harbor.

In 1887 it was proposed to straighten the passage through the Narrows by cutting off a spur that projected from Lovells Island, which was estimated to contain 20,000 cubic yards.

A revised project for the improvement of the main channel was submitted August 11, 1892. It proposed, in accordance with the act of July 13, 1892, to widen and deepen the channel so that it should be 1,000 feet wide and 27 feet deep at mean low water. This revised project was estimated to cost $1,250,000.

On June 30, 1893, the main ship channel was 23 feet deep at mean low water, 1,100 feet wide west of the upper middle, 850 feet wide at the upper middle, 1,000 feet wide at the lower middle, and at least 625 feet wide elsewhere.

In effecting this improvement dredging or blasting was done at the following places:

At Nashs Rock Shoal, during the years 1876–1878, 365 cubic yards of ledge were removed.

At Kellys Rock and Shoal, during the years 1869–1879, 222 cubic yards of ledge were removed.

Tower, Corwin, and Channel Rocks were removed during the years 1867–'75; they aggregated 608¾ cubic yards.

From the west end of Brewster Spit, during the years 1874–'76, 1891, and 1892, 57,736 cubic yards of sand and gravel were dredged, and 95½ cubic yards of ledge were removed.

At Lovells Island, from the southeast and southwest points, 267,294½ cubic yards were dredged during the years 1867–'77, and from the spur between these points 3,430 cubic yards were dredged in 1888.

At Castle Island Bar and Shoal, opposite the Lower Middle, during the years 1880–'83, 36,957 cubic yards were dredged and 20 tons of rock were removed.

At the Lower Middle, in 1874–'75, State and Palmyra rocks were removed; they aggregated 62 cubic yards. In 1887–'89, 71,892 cubic yards were dredged from this shoal and 375 cubic yards of ledge were removed.

At the Upper Middle, during the years 1870–'76, 1880–'93, 626,452½ cubic yards were dredged, and 229 cubic yards of ledge were removed.

At Anchorage Shoal, during the years 1879–'82, 65,327 cubic yards were dredged.

At Man-of-War Shoal, 85,917 cubic yards were dredged in the years 1878–'80.

At Mystic River Shoal, during the years 1879–'82, 82,082 cubic yards were dredged.

During the fiscal year operations were in progress under the contract of October 17, 1892, with Mr. Charles H. Souther, of Boston, Mass., and Mr. Augustus R. Wright, of Portland, Me., to dredge 500,000 cubic yards from the main ship channel, and 302,231 cubic yards were dredged, a total of 307,897 cubic yards removed under the contract.

The improved channel at the date of this report is 27 feet deep at mean low water, 300 feet wide at the shoal east of Nashs Rock, 1,000 feet wide at the shoal west of Nashs Rock, 500 feet wide at the Centurion Shoal. In the Narrows the channel has been dredged 700 feet wide, but ledges were uncovered which, until they are removed, prevent the use of the increased depth. These ledges contain 4,532 cubic yards above the proposed grade.

The remainder of the main ship channel is in the same condition as on June 30, 1893.

The appropriation for the project of August 11, 1892, has been $265,000.

The balance necessary to complete it, after the channel at the Upper Middle Bar has been widened in accordance with the original project (which it is estimated will cost $160,000), is $985,000.

The following tributary channels have been improved by dredging or blasting:

1. CHARLES RIVER.

This river empties into the inner harbor near the navy-yard at Charlestown.

Before improvement the natural channel had, so far up as Western avenue bridge, 4¾ miles from its mouth, 7 feet depth at mean low water, except in several places, covering about 1¼ miles in length below Brookline street bridge, where the depth varied from 4½ feet to 7.

From Western avenue bridge to Arsenal street bridge (2½ miles) there was a depth of 4 feet at mean low water, and thence to the dam at the head of tide water (1¾ miles) a depth varying from 0 to 9½ feet above mean low water. The mean rise or fall of the tide is 10 feet. A sketch showing the river was published in the Annual Report of the Chief of Engineers for 1884, page 512.

The project for the improvement of this river consists in straightening, widening, and deepening the natural channel, so that it shall be from its mouth to Western avenue bridge 7 feet deep at mean low water and 200 feet wide; from Western avenue bridge to Market street bridge 6 feet deep at mean low water and 80 feet wide; thence to the dam at the head of tide water 60 feet wide and 2 feet deep at mean low water.

The estimated cost of this improvement was originally $85,000. A revised estimate was submitted in 1881 of $125,000.

The total allotments from the appropriations for Boston Harbor for this work to date have been $77,500.

The expenditures to June 30, 1893, were $57,500.

No operations were in progress during the fiscal year, and the condition of the improvement on June 30, 1894, was as follows: The projected channel had been completed from the mouth of the river to Arsenal street bridge (7¼ miles); work was stopped at this point for the reason that the piers and draws of this bridge do not conform to the projected channel above it. In effecting this improvement 127,971 cubic yards were dredged during the years 1880–'84.

2. FORT POINT CHANNEL.

This channel is situated between the eastern shore of Boston proper on the one side and the reclaimed and improved flats of South Boston on the other side. It connects the tidal basin of South Bay, which has an area of 250 acres, with Boston inner harbor, is fast becoming the center of the city's most extensive shipping trade, and is the most important branch of the main ship channel. Fort Point channel is 1¼ miles long.

Before improvement the least depth at mean low water was 12 feet at its entrance, and 17 feet above Congress street bridge.

That part of it which it is proposed to improve is spanned by bridges at Congress street, Mount Washington avenue, and at an intermediate point. The bridges have conveniently located draw openings, but the draw piers of the railroad bridge must be strengthened or reconstructed before the improvement can be extended past them, and the width of the draw increased to that of the other bridges above and below it.

The project for this improvement was submitted January 27, 1885. It proposed the excavation of a channel 175 feet wide and 23 feet deep at mean low water from the entrance to near Federal street bridge, a distance of 4,100 feet, and was estimated to cost $100,000, the railroad bridge to be reconstructed at the expense of the owners.

By the act of August 5, 1886, $18,750 was allotted for the improvement of this channel from the appropriation for Boston Harbor.

The total expenditures to June 30, 1893, were $18,750.

No operations were in progress during the year, and the condition of the improvement June 30, 1894, is as follows: The channel is dredged as proposed from its entrance to Congress street bridge, a distance of 1,900 feet; 94,211 cubic yards were removed in effecting this improvement during the year 1887.

To complete the improvement as proposed to Federal street bridge will cost $60,000, and this sum could be expended to advantage during the fiscal year ending June 30, 1896, if the railroad draw shall have been properly reconstructed.

3. HINGHAM HARBOR.

See separate report.

4. NANTASKET BEACH CHANNEL.

This is a small channel along the east side of Hingham or Hull basin. It leads to a wharf on the west side of the heel of Nantasket Beach, about 12 miles from Boston.

Before improvement it was approximately 100 feet wide and had a depth of at least 11 feet, except at the eastern end, 1,500 feet from the wharf, where the width was reduced to from 40 to 50 feet, and the depth to less than 8 feet. It was circuitous and obstructed by bowlders at the mouth of Weir River, and by a ledge near the wharf.

The project of improvement, adopted in 1880 and completed in 1881–'83, was to widen and deepen the channel from the mouth of Weir River to the steamboat wharf, so that it would be 100 feet wide and 9½ feet deep at mean low water, to remove a few bowlders at the mouth of Weir River, and to remove the ledge near the wharf.

In 1891, in accordance with the act of September 19, 1890, the channel was widened to 150 feet.

The total allotments for this work from the appropriations for Boston Harbor to date have been $31,067.80, of which $30,045.69 have been expended to June 30, 1894.

On June 30, 1893, operations were in progress under the contract of September 22, 1892, with Mr. Augustus B. Martin, of Boston, Mass.; this contract was completed July 12, 1893, and at the date of this report the improved channel is 150 feet wide and 12 feet deep at mean low water, except over the ledge at the steamboat wharf.

During the year $10,228.21 were expended on this improvement.

Tonnage of the channel in—	Tons.	Tonnage of the channel in—	Tons.
1874	390,226	1891	800,000
1889	654,920	1892	820,000
1890	703,340	1893	835,000

5. CHANNEL BETWEEN NIXS MATE AND LONG ISLAND.

This is a channel through the bar which extends from the north head of Long Island to Nixs Mate Shoal. Previous to improvement there was 4½ feet depth of water on the bar at mean low tide.

The project for the improvement was adopted in 1883. It was to dredge a channel 200 feet wide, 12 feet deep at mean low water, and about 550 feet long. In 1887 it was recommended that the axis of the cut be shifted 30 degrees to the westward, and that it be widened to 300 feet and made 15 feet at mean low water. The original project was estimated to cost $9,000. The project of 1887 was estimated to cost $25,000 additional. No specific appropriation has been made for this work. The expenditures on it to June 30, 1893, from the appropriations for Boston Harbor, were $24,982.97. No operations were in progress during the fiscal year, and at the date of this report the channel is 300 feet wide, 15 feet deep at mean low water.

6. BROAD SOUND.

An obstruction called Barrel Rock, lying on the north side of the Broad Sound Channel, was removed in 1869. It contained 116 cubic yards.

7. JEFFREYS POINT CHANNEL.

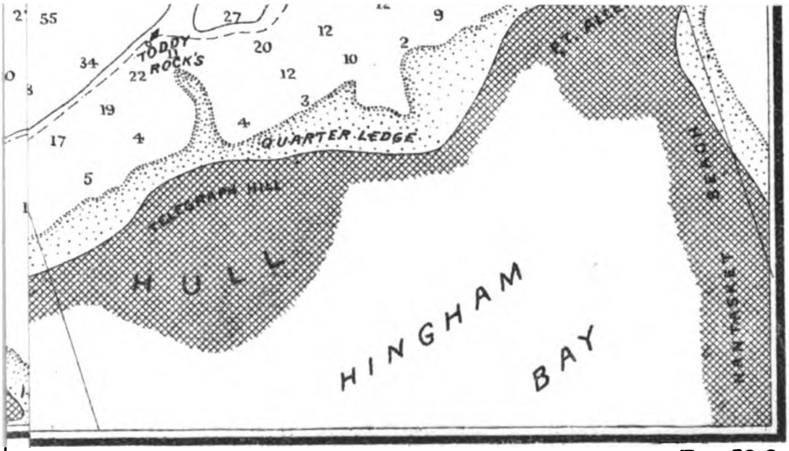
This channel is an extension of the main ship channel from near Grand Junction Wharf (East Boston) toward Jeffreys Point.

A project for its improvement was submitted December 2, 1890, in accordance with the act of September 19, 1890. It was proposed to dredge a channel 400 feet wide from Grand Junction Wharf to just east of Simpson's Patent Dry Docks, and 18 feet deep at mean low water. Thence gradually narrowing the proposed channel to 250 feet, and decreasing the depth of water to 15 feet at mean low water to a junction with the same depth off Jeffreys Point. This was estimated to cost $50,000.

The total allotments for this work to date, from the appropriations for Boston Harbor, have been $50,000.

The expenditures to June 30, 1893, were $32,863.09.

On June 30, 1893, the improved channel was 350 feet wide from Grand Junction Wharf to just east of the dry docks, 18 feet deep at



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mean low water, and thence to Jeffreys Point the channel was completed as proposed.

A contract was in force with Mr. Charles H. Souther, of Boston, Mass., to dredge 55,000 cubic yards from this channel.

This contract was dated September 30, 1892, and operations under it were commenced in October, 1892; were suspended in November, 1892; recommenced in September, 1893, and completed in November, 1893. During the fiscal year 39,196 cubic yards were dredged, a total of 59,893 yards removed under the contract.

At the date of this report the improvement is completed.

The expenditures for this channel during the year were $14,882.66.

Recapitulation of amounts which could be expended to advantage during the fiscal year ending June 30, 1896.

Extension of Point Allerton sea wall	$15,000
Sea wall for Georges Island	35,000
Sea walls for Governors Island	80,000
Widening main ship channel at Upper Middle	160,000
Completion of Fort Point Channel	60,000
Continuation of revised project for main channel	350,000
Total	700,000

The several works completed and projected for the improvement of this harbor are located in the collection district of Boston and Charlestown, Mass. Boston is the port of entry.

The accompanying commercial statistics for the fiscal year ending June 30, 1894, have been furnished by the collector of customs at Boston, Mass.

The dates and amounts of the appropriations for this work are as follows:

Act of—		Act of—	
March 2, 1825	$52,972.56	July 12, 1866	$75,000.00
March 19, 1828	2,000.00	March 2, 1867	375,000.00
May 23, 1828	87,000.00	July 11, 1870	100,000.00
March 2, 1829	7,310.54	March 3, 1871	100,000.00
March 2, 1831	5,000.00	June 10, 1872	75,000.00
February 24, 1832	9,000.00	March 3, 1873	150,000.00
March 2, 1831	12,390.00	June 23, 1874	100,000.00
July 3, 1832	60,000.00	March 3, 1875	100,000.00
March 3, 1841	1,500.00	August 14, 1876	50,000.00
August 31, 1842	2,000.00	June 18, 1878	55,000.00
July 4, 1836	15,000.00	March 3, 1879	50,000.00
July 7, 1838	7,353.00	June 14, 1880	75,000.00
March 3, 1841	1,000.00	March 3, 1881	100,000.00
March 3, 1843	16,000.00	August 2, 1882	96,500.00
July 2, 1864	10,000.00	July 5, 1884	5,000.00
February 28, 1865	3,000.00	August 5, 1886	56,250.00
June 12, 1866	50,000.00	August 11, 1888	125,000.00
July 20, 1848	40,000.00	September 19, 1890	145,000.00
August 30, 1852	30,000.00	July 13, 1892	300,000.00
July 2, 1864	40,000.00		
February 28, 1865	20,000.00	Total	2,604,276.10

Money statement.

July 1, 1893, balance unexpended		$339,412.30
June 30, 1894, amount expended during fiscal year		157,280.63
July 1, 1894, balance unexpended		182,131.67
July 1, 1894, outstanding liabilities	$30,206.89	
July 1, 1894, amount covered by uncompleted contracts	83,219.07	
		113,425.96
July 1, 1894, balance available		68,705.71

Amount (estimated) required for completion of existing project	$1,335,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	700,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

COMMERCIAL STATISTICS.

Amount of revenue collected, 1892, $14,491,854.98; 1893, $15,791,588.16; 1894, $8,981,449.98.

Shipping.	1892.		1893.		1894.	
	No.	*Tons.*	*No.*	*Tons.*	*No.*	*Tons.*
Entrances:						
Foreign	2,262	1,663,711	2,373	1,633,740	2,096	1,696,108
Clearances:						
Foreign	2,181	1,406,650	2,231	1,330,165	2,032	1,432,167

	1892.	1893.	1894.
Importations:			
Merchandise	$71,780,489	$79,357,654	$50,319,331
Coin and bullion	12,944	29,207	450,750
Exportations:			
Foreign merchandise	564,140	805,265	1,131,114
Domestic merchandise	86,610,057	84,596,157	82,842,346
Coin and bullion	....	2,250,250	2,150,000

B 14.

IMPROVEMENT OF WEYMOUTH RIVER, MASSACHUSETTS.

Weymouth (Fore) River, tributary to Hingham Bay, Boston Harbor, Massachusetts, is one of the most important water courses on the south coast of Massachusetts Bay. It is navigable at low water for vessels not exceeding 18 feet draft for 4 miles from its mouth, and for a further distance of 3 miles, to the head of navigation, at least 3 feet depth was found at mean low water before its improvement.

The original project of improvement was submitted December 2, 1889. It was based on the survey provided for in the act of August 11, 1888, and proposed to improve the natural channel of the river by dredging, so that 6 feet depth at mean low water could be carried to the head of navigation, in a channel 100 feet wide near the wharves at Weymouth Landing; thence to Braintree bridge, 80 feet wide, and above the bridge 50 feet wide, with increased width at each turn to facilitate the movement of vessels. The total length of channel to be improved was 7,000 feet, approximately, and the cost was estimated to be $40,000.

The total appropriations for this work to date have been $20,000.

The expenditures to June 30, 1893, were $10,038.64.

On June 30, 1893, the improved channel was 6 feet deep at mean low water, 40 feet wide to Braintree bridge, and 25 feet wide thence to the head of navigation.

No operations were in progress during the fiscal year, and at the date of this report the improvement is in the same condition as on June 30, 1893.

The amount required to complete the improvement is $20,000, all of which could be expended to advantage during the fiscal year ending June 30, 1896.

Weymouth River is in the collection district of Boston, Mass., of which Boston is the port of entry. The nearest light-house is on Long Island, Boston Harbor, Massachusetts.

Commercial statistics are included in the statement for Boston Harbor, Massachusetts.

The dates and amounts of the appropriations for this work are as follows:

By act of—	
September 19, 1890	$10,000
July 13, 1892	10,000

Money statement.

July 1, 1893, balance unexpended	$9,961.36
July 1, 1894, balance unexpended	9,961.36
Amount (estimated) required for completion of existing project	20,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	20,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

B 15.

IMPROVEMENT OF HARBOR AT HINGHAM, MASSACHUSETTS.

Hingham Harbor is situated in the southern part of Hingham or Hull Basin, which comprises all that part of Boston lower harbor south of Nantasket Roads.

A chart of the harbor was published in the Annual Report of the Chief of Engineers for 1888, Part I, p. 456.

The harbor covers an area of 1 square mile, and has extensive mud flats bare at low tide.

The mean rise or fall of the tide is 9.4 feet.

The channel leading to Hingham, south of Ragged and Sailor islands, was, before improvement, very narrow and crooked, and obstructed by sunken rocks and shoals. Its least width was 30 feet and least depth 4 feet at mean low water.

The object of its improvement was to widen and deepen the natural channel from deep water, near the head of the harbor, to the steamboat wharf, a distance of 2,500 feet.

The original project of improvement was submitted December 23, 1874.

It provides for an improved channel on the east side of Sailor Island, past the west side of Beacon to the Hingham wharf, 100 feet wide and 8 feet deep at mean low water, at an estimated cost of $11,000.

This project was modified January 20, 1885, when it was proposed to deepen the improved channel to 10 feet at mean low water and to remove a mid-channel ledge, lying between Chandler and Ragged islands, at an estimated cost of $18,750.

The total amount appropriated for this work to date is $29,000.

The expenditures to June 30, 1893, were $28,985.76, and the project for the improvement of the harbor was completed.

No operations were in progress during the fiscal year, and at the date of this report the improved channel is in good order.

Hingham Harbor is in the collection district of Boston, Mass. The nearest light-house is the Narrows Light, on the main ship channel in Boston Harbor, 5 miles distant.

The dates and amounts of the appropriations for this work are as follows:

Allotted from appropriation for Boston Harbor, act of March 3, 1875	$10,000
Act of—	
March 5, 1886	6,000
August 11, 1888	5,000
September 19, 1890	5,000
July 13, 1892	3,000
Total	29,000

Commercial statistics are included in the statement for Boston Harbor.

Money statement.

July 1, 1893, balance unexpended	$14.24
June 30, 1894, amount expended during fiscal year	14.24

B 16.

IMPROVEMENT OF HARBOR AT SCITUATE, MASSACHUSETTS.

Scituate Harbor is on the west shore of Massachusetts Bay, 14 miles from either Boston or Plymouth light-houses, and just southwest of the direct sailing course of all ocean-going vessels entering Boston Harbor.

Before improvement the harbor had a low-water area of 57 acres, approximately, more than 6 acres of which had a depth of at least 3 feet at mean low water. It was entirely open to the action of east winds, and the entrance was obstructed by many sunken bowlders. The depth on the bar was about 2½ feet at mean low water. The mean rise or fall of the tide is 9.8 feet.

The plan of the harbor showing the proposed improvement was published in the Annual Report of the Chief of Engineers for 1881, Part I, p. 522.

The object of the improvement is to create a harbor of refuge for vessels bound to Boston which are too far south of their course to clear the dangerous ledges near Minots light-house.

The project for the improvement, adopted in 1881, is to build two rubblestone breakwaters converging from opposite shores, and to dredge an anchorage basin with channels connecting with the sea and the town wharves.

The north breakwater, from Cedar Point, is to be 800 feet long; and the south breakwater, from the point of the first cliff, is to be 730 feet long. Both breakwaters are to be 20 feet wide on top and 4 feet above mean high water, except at their outer ends, which are to be built 6 feet higher, to serve as sites for entrance beacons. The anchorge basin is to be 30 acres in area, approximately. The entrance channel is to be 2,700 feet long and 300 feet average width.

The estimated amount of dredging (including the entrance channel) was 500,000 cubic yards, to give a depth of 15 feet in the entrance channel; 12 to 15 feet between the breakwaters, 12 feet immediately in rear of the south breakwater, and 10 feet for the anchorage basin; the channel leading to the town wharves is to be 3 feet deep, all at mean low water.

The estimated cost of the breakwaters was $100,000, and of the dredging $190,000, a total of $290,000.

The total amount appropriated for this work to date is $73,680.

The amount expended to June 30, 1893, was $69,959.84.

The condition of the improvement June 30, 1893, was as follows:

A portion of the beach between Cedar Point and the mainland was protected by a brush and stone bulkhead 450 feet long, in front of which was a stone apron 10 feet wide, 385 feet long.

All known bowlders obstructing the entrance of the harbor were removed.

The anchorage basin was 400 by 350 feet in area, 7 feet deep at mean low water.

The entrance channel was 1,600 feet long, 100 feet wide, and 5 feet deep at mean low water. The channel connecting the basin with the town wharves was 3 feet deep at mean low water, and 100 feet wide, except at the upper end, where for a distance of 75 feet it averaged only 50 feet wide.

The north breakwater was 720 feet long, the south breakwater was 250 feet long, and operations were in progress under a contract with Mr. Joseph H. White, of Boston, Mass., to deposit 3,643 tons of rubblestone in the south breakwater.

Operations under this contract were commenced in September, 1893. A total of 3,643½ tons of rubblestone were deposited in the south breakwater, and 300 feet of its length were completed.

No other operations were in progress during the fiscal year, and at the date of this report the north breakwater, the entrance channel, the anchorage basin, and the channel leading to the town wharves, are in the same condition as on June 30, 1893.

To complete the improvement will require an appropriation of $217,500, of which $40,000 could be expended to advantage during the fiscal year ending June 30, 1896, in completing the south breakwater.

Scituate is in the collection district of Plymouth, Mass., of which the port of entry is Plymouth, Mass.; the nearest light-house is Minots Light, about 5 miles distant.

The accompanying commercial statistics have been furnished by the collector of customs at Plymouth, Mass.

The dates and amounts of the appropriations for this work are as follows:

Act of—		Act of—	
March 2, 1829	$180	August 5, 1886	$10,000
August 30, 1852	1,000	August 11, 1888	5,000
June 14, 1880	7,500	September 19, 1890	10,000
March 3, 1881	10,000	July 13, 1892	10,000
August 2, 1882	10,000		
July 5, 1884	10,000	Total	73,680

Appropriations since 1880 have been expended in accordance with the present project.

Money statement.

July 1, 1893, balance unexpended	$3,720.16
June 30, 1894, amount expended during fiscal year	3,675.95
July 1, 1894, balance unexpended	44.21
Amount (estimated) required for completion of existing project	217,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	40,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

COMMERCIAL STATISTICS.

Amount of revenue collected, 1892, $31.50; 1893, none; 1894, none.

Shipping.	1892.		1893.		1894.	
	No.	*Tons.*	*No.*	*Tons.*	*No.*	*Tons.*
Entrances:						
Foreign	1	100	2	205	2	....
Domestic	29	3,000	22	3,080	35	....
Clearances:						
Foreign	1	....	....	....	2	....
Domestic	29	....	....	....	35	....

Imported.	1892.	1893.	1894.
Coal ... tons	3,000	2,500	3,000
Lumber ... feet	1,500,000	1,000,000	1,800,000
Lime ... barrels	250	1,000	1,000
Brick ... number	25,000	150,000	300,000
Shingles ... do	....	....	3,000,000
Miscellaneous	....	*1,000	†9,000

* Barrels herring. † Barrels Irish moss.

Coasting vessels drawing from 8 to 11 feet frequent the harbor.

B 17.

IMPROVEMENT OF HARBOR AT PLYMOUTH, MASSACHUSETTS.

Plymouth Harbor is situated 30 miles south of Boston. Its outer anchorage, the "Cow Yard," is common to Plymouth, Kingston and Duxbury, and is the only refuge for seagoing vessels from northeasterly gales, when caught between Boston and Provincetown, a distance of about 75 miles, following the coast line. The entrance to this outer anchorage is direct, unobstructed, of ample width, and sufficiently deep for the wants of commerce. The anchorage is capacious, and has good "holding ground," but the extensive tidal basins inside of it give strong variable currents across it.

The inner or harbor proper is formed by Long Beach, a narrow, low sand spit 3 miles long, which extends generally parallel to the mainland, and about 1 mile from it.

The harbor contains about 2,000 acres, almost all of which is dry at low tide. A few narrow, crooked channels traverse these flats. They join about the center of the harbor, opposite the town wharves, and form the main ship channel (150 feet wide, approximately, and 10 feet deep at mean low water), which runs directly behind the northern half of Long Beach to the outer anchorage.

The maintenance of this inner harbor and channel depends on the preservation of Long Beach.

A chart of the harbor was published in the Annual Report of the Chief of Engineers for the year 1888, Part I, p. 460.

Before improvement about 6 inches depth of water could be carried to the town wharves at low tide.

Previous to 1875 the project was a general one, and had for its object the preservation of Long Beach. From the nature of the work it can at no time be considered completed, and small annual appropriations are necessary to repair any damages done by storms. The various devices employed for this purpose are described in the Annual Report of the Chief of Engineers for 1877.

The project for the improvement of the harbor was first adopted in 1875. It provided for dredging a channel from the town wharves to the main ship channel, 2,286 feet long, 100 feet wide, and 6 feet deep at mean low water. This project was modified in 1877, so as to include the dredging of a basin, 866 feet long, 150 feet wide, and 8 feet deep, directly in front of the town wharves.

In 1884 and 1885 it was proposed to deepen the channel and basin to 9 feet at mean low water, and to make the channel 150 feet wide.

The modified project of 1884 required the excavation of 81,000 cubic yards (scow measurement), and was originally estimated to cost $27,000. This estimate was revised in 1885, in accordance with the low prices then current for dredging, and the cost was then estimated to be $22,500.

From 1824 to date the amount appropriated for this harbor is $179,766.90, of which there had been expended to June 30, 1893:

For beach protection	$122,553.77
For dredging	50,514.89
Total	173,068.66

On June 30, 1893, the improved channel was 2,286 feet long, 150 feet wide; the basin was 866 feet long, 150 feet wide; both were 9 feet deep at mean low water. Long Beach was in fair order, but additional bulkheads were needed on its southern end.

During the fiscal year a small force of hired labor was employed in repairing and extending the bulkheads protecting the south end of Long Beach. Three thousand running feet of bulkheads were built or rebuilt.

At the date of this report Long Beach is in good order, and the project for the improvement of the harbor is completed.

A small sum should always be available for the harbor to immediately repair any damage made to Long Beach by storms. These necessary repairs have averaged, in the last twenty years, $1,500.

Plymouth Harbor is in the collection district of Plymouth, Mass., of which Plymouth is the port of entry. The nearest light-houses are the Plymouth (Gurnet) Lights, about 5 miles from Plymouth, and Duxbury Pier Light, about 2 miles distant.

The accompanying commercial statistics for the fiscal year ending June 30, 1894, have been furnished by the collector of customs at Plymouth, Mass.

The dates and amounts of appropriations for this harbor are as follows:

Act of—		Act of—	
May 26, 1824	$20,000.00	March 3, 1873	$3,000.00
March 3, 1825	5,712.00	June 23, 1874	5,000.00
March 25, 1826	13,184.90	March 3, 1875	10,000.00
April 23, 1830	1,850.00	June 18, 1878	5,000.00
March 2, 1831	2,820.00	March 3, 1879	3,500.00
July 3, 1832	2,500.00	June 14, 1880	10,000.00
March 2, 1833	600.00	March 3, 1881	10,000.00
June 28, 1834	2,000.00	August 2, 1882	14,000.00
March 3, 1835	700.00	July 5, 1884	10,000.00
July 2, 1836	500.00	August 5, 1886	6,000.00
July 7, 1838	2,400.00	August 11, 1888	6,000.00
August 31, 1852	5,000.00	September 19, 1890	8,000.00
July 11, 1870	10,000.00	July 13, 1892	9,500.00
March 3, 1871	10,000.00		
June 10, 1872	2,500.00	Total	179,766.90

Money statement.

July 1, 1893, balance unexpended	$6,698.24
June 30, 1894, amount expended during fiscal year	4,680.65
July 1, 1894, balance unexpended	2,017.59
Amount (estimated) required for completion of existing project	1,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	1,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

COMMERCIAL STATISTICS.

Amount of revenue collected, 1892, $73,808.36; 1893, $47,330.06; 1894, $24,073.13.

Shipping.	1892.		1893.		1894.	
	No.	*Tons.*	*No.*	*Tons.*	*No.*	*Tons.*
Entrances:						
Foreign	2	196	3	286	1	[illegible]
Domestic	103	....	108	....	95	..
Clearances:						
Foreign	9	1,817	8	1,721	5	1 [illegible]
Domestic	......	....	......	....	......	....

Imported.		1892.	1893.	1894.
Coal	tons	16,861	19,094	24,285
Iron	do	1,443	650	1,512
Lumber	feet	3,303,463	2,085,000	2,260,000
Sand	tons	295	140	....
Miscellaneous	do	1,145	2,173	....

Coasting vessels drawing from 7 to 13 feet frequent the harbor.

B 18.

IMPROVEMENT OF HARBOR AT KINGSTON, MASSACHUSETTS.

Kingston Harbor is one of the three divisions which together constitute Plymouth inner harbor. North of it, at a distance of 3 miles, is Duxbury Harbor, and 4 miles south, Plymouth Harbor.

The wharf at which supplies are landed for the town of Kingston is about 2 miles south from the center of the town, and is known as the Plymouth Cordage Company Wharf.

The object of the improvement is to obtain a channel of approach to this wharf.

The project for the improvement of the harbor was submitted May 25, 1891. It proposed to dredge a channel 4,000 feet long, 100 feet wide, 6 feet deep at mean low water, from deep water to the Cordage Company Wharf, at an estimated cost of $10,000.

The act approved July 13, 1892, appropriated $10,000 for this work.

The total expenditures to June 30, 1893, were $8,937.64, and on that date the project had been completed.

No operations were in progress during the fiscal year, and at the date of this report the improved channel is in good order.

Kingston is in the collection district of Plymouth, Mass., of which Plymouth is the port of entry; the nearest light-house is Duxbury Pier Light.

Commercial statistics are included in the statement for Plymouth Harbor.

Money statement.

July 1, 1893, balance unexpended	$8,625.46
June 30, 1894, amount expended during fiscal year	7,565.55
July 1, 1894, balance unexpended	1,059.91

B 19.

IMPROVEMENT OF HARBOR AT WELLFLEET, MASSACHUSETTS.

Wellfleet Harbor is situated on Cape Cod Bay, 12 miles southeast of Provincetown Harbor, Massachusetts.

A chart of the harbor was published in the Annual Report of the Chief of Engineers for the year 1888, Part I, p. 478.

The harbor consists of an outer anchorage south of Smalley's Bar and an inner harbor north of said bar.

The outer harbor is sufficiently capacious, free from obstructions, and protected to meet the present demands of commerce; but the inner harbor, although capacious and perfectly protected, had no low-water navigable connection with the town wharves.

It was, in the original condition of the harbor, 4,200 feet from the 6-foot contour to the wharves, and not to exceed 6 inches draft could be carried to them at low water.

The original project for the improvement of this harbor was submitted November 3, 1871. It was based on the survey provided for in the act of January 31, 1871.

It proposed to dredge two channels, each 150 feet wide and 4 feet deep at mean low water, one 2,060 feet long to reach Central and Commercial wharves, and one 1,400 feet long to reach Mercantile Wharf. It was also proposed to remove 204 cubic yards of sunken rocks. The cost of this project was estimated to be $30,000.

On November 28, 1887, a revised project was submitted. It was based on the survey provided for in the act of August 5, 1886. It proposed to dredge a channel from the "Deep Hole" to the town wharves, 6 feet deep at mean low water, 100 feet wide, and 4,200 feet long, at an estimated cost of $24,000.

This estimate was revised in 1889, and then made $31,000.

The total appropriations for this harbor to date have been $16,000.

By act of—	
June 10, 1872	$5,000
August 11, 1888	7,000
September 19, 1890	4,000
Total	16,000

The total amount expended to June 30, 1893, was $11,350.37, and the condition of the improvement was as follows: Mayo, Bay, Lobster, and Lumpfish rocks had been removed, and a channel had been dredged from the "Deep Hole" to the town wharves, 4,200 feet long, 4 feet deep at mean low water, and 25 feet wide. Opposite the town wharves the channel was enlarged to 75 feet wide to facilitate the docking of vessels.

The act of September 19, 1890, appropriated $4,000 to continue this improvement. No appreciable benefit to commerce would result by the expenditure of this amount, and it is to be retained in the Treasury until additional funds are provided.

To complete the improvement will require an appropriation of $22,000, all of which could be expended to advantage during the fiscal year ending June 30, 1896.

The accompanying commercial statistics for the fiscal year ending June 30, 1894, have been furnished by the collector of customs at Barnstable, Mass.

Wellfleet is in the collection district of Barnstable, Mass., of which Barnstable is the port of entry. The nearest light-house is Mayo Beach Light.

Money statement.

July 1, 1893, balance unexpended	$4,649.63
July 1, 1894, balance unexpended	4,649.63
Amount (estimated) required for completion of existing project	22,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	22,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

COMMERCIAL STATISTICS.

Amount of revenue collected, 1892, $91.60; 1893, $53; 1894, $53.

Shipping.	1892.		1893.		1894.	
	No.	*Tons.*	*No.*	*Tons.*	*No.*	*Tons.*
Entrances:						
Foreign						
Domestic						
Clearances:						
Foreign			1	78	2	170
Domestic						

Imported.	1892.	1893.	1894.
	Tons.	*Tons.*	*Tons.*
Coal	1,200	1,000	1,500
Lumber		100	
Merchandise	200		250
Miscellaneous	100	10	51

Vessels drawing from 5 to 12 feet frequent the harbor.

B 20.

IMPROVEMENT OF HARBOR AT PROVINCETOWN, MASSACHUSETTS.

Provincetown Harbor is situated at the extremity of Cape Cod, about 40 miles southeast from Boston Light. It is one of the most valuable harbors of refuge on the Atlantic coast. The entire commerce of New England and a very large local fishing interest are directly benefited by its maintenance, which depends entirely on the preservation of the sandy beaches which inclose it.

Since 1826 the project has been a general one, and provides for the preservation of the harbor by building dikes, bulkheads, and sand-catches, and extensive planting of beach grass to repair or prevent storm damages to the beaches.

From the nature of the work it can at no time be considered completed.

A full history of the improvement will be found in the Annual Reports of the Chief of Engineers for the years 1876, 1879, and 1886. A special dike across House Point Island Flats, to be built contingently, was recommended in the Annual Report for 1886.

A plan of the harbor was published in the Annual Report of the Chief of Engineers for 1886.

The total appropriations for this harbor to date have been $152,918.44.

The amount expended to June 30, 1893, was $147,677.49.

The condition of the several works of preservation in this harbor on June 30, 1893, was as follows:

Long Point.—This long, narrow, low point forms the southeastern limit of the harbor. It was in good order, but to more fully protect the light-house lot at its easterly end the breakwater should be extended 100 feet farther to the northwest.

Abel Hill Dike.—This dike was built to prevent a rush of water from Lanceys Harbor over House Point Island Flats into the main harbor. The rapid wearing away of the southern sand spit that formed Lanceys Harbor had threatened to make a breach through the beach south of the dike. To guard against this, brush and wooden sand-catches had been built on the outer beach, opposite the west end of the dike. The dike was in good order, but the sand-catches needed minor repairs.

House Point Island Flats.—These flats remained essentially unaltered from the condition shown by the last survey, and, as stated in the Annual Report for 1887, it still appears unnecessary to commence the dike projected to be built across these flats.

Beach Point, High Head Dike, and Cove Section.—These works were all in good order.

During the fiscal year no active operations were in progress, and at the date of this report all of the works of preservation are in good order, with the exception of the brush and wooden sand-catches at the west end of Abel Hill Dike. They need minor repairs, for which the available funds will suffice.

The nature of the works of preservation of the harbor requires a small sum to be always available for immediate repairs. Such necessary repairs have averaged $1,500 per annum.

The prospective benefit to commerce is the preservation of an important harbor of refuge.

The accompanying commercial statistics have been furnished by the collector of customs at Provincetown, Mass.

Provincetown is a port of entry in the collection district of Barnstable, Mass.; the nearest light-houses are Wood End and Long Point lights.

The dates and amounts of the appropriations for this work are as follows:

Act of—	
May 19, 1826	$3,500.00
March 2, 1829	3,500.00
March 2, 1831	2,050.00
March 3, 1832	4,600.00
June 28, 1834	4,400.00
March 3, 1835	4,400.00
July 2, 1836	4,400.00
July 7, 1838	4,500.00
August 30, 1852	5,000.00
June 23, 1866	43,068.44
July 28, 1866	8,000.00
March 3, 1871	6,000.00
June 10, 1872	5,000.00
March 3, 1873	6,000.00
June 23, 1874	6,000.00
March 3, 1875	$5,000.00
August 14, 1876	4,000.00
June 18, 1878	1,000.00
March 3, 1879	1,000.00
June 14, 1880	500.00
March 3, 1881	5,000.00
August 2, 1882	5,000.00
July 5, 1884	2,000.00
August 5, 1886	3,000.00
August 11, 1888	3,000.00
September 19, 1890	7,500.00
July 13, 1892	1,500.00
Total	152,918.44

Money statement.

July 1, 1893, balance unexpended	$5,240.95
July 1, 1894, balance unexpended	5,240.95
Amount (estimated) required for completion of existing project	1,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	1,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

COMMERCIAL STATISTICS.

Amount of revenue collected, 1892, $571.47; 1893, $492.77; 1894, ——.

Shipping.	1892.		1893.		1894.	
	No.	*Tons.*	*No.*	*Tons.*	*No.*	*Tons.*
Entrances:						
Foreign	44	6,358	56	8,781	29	4,353
Domestic	13	756	14	800	18	1,260
Clearances:						
Foreign	26	2,919	22	2,627	15	....
Domestic	18	4,466	27	6,750	3	....

Imported.	1892.	1893.	1894.
	Tons.	*Tons.*	*Tons.*
Coal	6,000	6,500	5,000
Iron	....	1,500	50
Wood	*300	....	*250
Lumber	7,140	1,500	†1,500,000
Salt	500	....	675
Ice	80	....	....
Fish	1,500	....	....
Miscellaneous	740	3,800	3,160

* Cords. † Feet.

All classes and nationalities of vessels visit the harbor for shelter or with cargo. Forty-five hundred vessels entered the harbor during the year.

B 21.

IMPROVEMENT OF HARBOR AT CHATHAM, MASSACHUSETTS.

Chatham Harbor is at the eastern end of Nantucket Sound, about 15 miles east of Hyannis, Mass. Its outer anchorage, known as Chatham Roads, is a capacious, deep, unobstructed harbor of refuge from northerly and easterly gales.

The inner harbor, locally known as "Stage" Harbor, is small but well landlocked. It is about one-half mile long, 500 to 600 feet wide, and has 8 to 12 feet depth at mean low water. Its entrance was originally obstructed by three bars, on which the depth at mean low water was not to exceed 4 feet. The mean rise or fall of the tide is 5 feet.

The project for the improvement of the inner harbor was submitted December 19, 1890, and was based on a survey made in October, 1890. It proposed to dredge a channel 6 feet deep at mean low water, through the three obstructing bars, 100 feet wide at the inner bar, 150 feet wide at the middle bar, and 200 feet wide at the outer bar, at an estimated cost of $10,000.

But one appropriation has been made for this work, viz, by the act of September 9, 1890, $5,000.

The total expenditures to June 30, 1893, were $4,402.15.

On June 30, 1893, the improved channel through the middle and inner bars was 100 feet wide, 6 feet deep at mean low water. Nothing had been done on the outer bar. At least 5 feet draft could be carried into the harbor at mean low water.

No operations were in progress during the fiscal year, and at the date of this report the condition of the improvement is the same as on June 30, 1893.

To complete the improvement would require an appropriation of $5,000, all of which could be expended during the fiscal year ending June 30, 1896.

Chatham Harbor is in the collection district of Barnstable, Mass., of which Barnstable is the port of entry; the nearest light-house is Hardings Beach Light.

The accompanying commercial statistics have been furnished by the collector of customs at Barnstable, Mass.

Money statement.

July 1, 1893, balance unexpended	$597.85
July 1, 1894, balance unexpended	597.85
Amount (estimated) required for completion of existing project	5,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	5,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

COMMERCIAL STATISTICS.

Shipping.	1892.		1893.		1894.	
	No.	Tons.	No.	Tons.	No.	Tons.
Entrances:						
Foreign						
Domestic					125	1,517
Clearances:						
Foreign						
Domestic					125	1,517

Imported.	1892.	1893.	1894.
	Tons.	Tons.	Tons.
Coal	3,000	2,000	1,200
Iron		5	
Grain		1,000	
Lumber	1,000	1,000	* 200,000
Miscellaneous	4,000	1,000	100

* Feet.

Vessels of all kinds drawing from 2 to 10 feet frequent the harbor for shelter or with cargo.

B 22.

REMOVING SUNKEN VESSELS OR CRAFT OBSTRUCTING OR ENDANGERING NAVIGATION.

On August 7, 1893, the wreck of the schooner *Wildfire* in Provincetown Harbor, Massachusetts, was reported to be an obstruction to navigation, and its removal recommended, at an expense of $1,000, as estimated.

Sealed proposals for this work were invited by public advertisement, dated August 12, 1893. The bids received were opened September 22, 1893, and an abstract of them will be found in the annexed table.

On October 6, 1893, a contract was entered into with Mr. D. A. Johnston, of Camden, N. J. Operations under this contract were commenced early in November, 1893, and the work was satisfactorily completed on December 2, 1893.

The total expense was $684.42.

On October 10, 1893, the wrecks of three unknown schooners off Chatham, Mass., were reported to be obstructions to navigation, and their removal recommended, at an estimated cost of $3,000.

Sealed proposals for this work were invited by public advertisement, dated October 20, 1893, and the bids received were opened December 1, 1893. An abstract of them will be found in the annexed table.

The specifications called for a separate bid for each wreck, to cover the contingency that one or more may be removed by storms or otherwise before work could be done on it.

From December 12 to 16, 1893, search was made for the wrecks by a party of hired labor, and but one could be found, numbered 2 in the specifications.

On December 18, 1893, a contract was entered into with Messrs. Johnston & Townsend, of Somers Point, N. J., for the removal of this wreck.

Operations under this contract were commenced immediately and satisfactorily completed December 29, 1893.

The total cost was $526.08.

On December 12, 1893, the wreck of the steamship *Perit* on Chatham Bar, Massachusetts, was reported to be an obstruction to navigation, and its removal recommended by hired labor, at an estimated cost of $600.

Operations were commenced January 1, 1894, and the wreck was removed to the level of the surrounding bottom on February 1, 1894.

The cost was $276.25.

Abstract of proposals for removing wreck of schooner Wildfire in Provincetown Harbor, Massachusetts, opened September 22, 1893, by Lieut. Col. S. M. Mansfield, Corps of Engineers.

No.	Name and address of bidder.	Amount.
1	Geo. W. Townsend, Boston, Mass	$689
2	C. J. Kelly and G. M. Van Sant, Atlantic City, N. J	863
3	D. A. Johnston, New York, N. Y.*	575
4	C. W. Johnston and E. Townsend, Somers Point, N. J	749
5	Thomas Liddle, East Boston, Mass	1,400
6	Judson R. Nash, East Boston, Mass	735

*Lowest bid.

Contract awarded to Mr. D. A. Johnston, with the approval of the Chief of Engineers.

Abstract of proposals for removal of masts and spars of wrecks of three unknown schooners off Chatham, Mass., opened December 1, 1893, by Lieut. Col. S. M. Mansfield, Corps of Engineers.

No.	Name and address of bidder.	Price bid.	Total.
*1	Charles W. Johnston and Enoch Townsend, Somers Point, N. J	$249 274 249	$772
2	D. A. Johnston, Camden, N. J., and R. McIntosh, Provincetown, Mass	800 600 500	1,900
3	Cornelius J. Kelly and Gilbert M. Van Sant, Atlantic City, N. J	445 445 445	1,335

* Lowest bid; will remove the three wrecks for $524.50.

Contract awarded to Johnston & Townsend, with the approval of the Chief of Engineers.

APPENDIX C.

IMPROVEMENT OF RIVERS AND HARBORS IN SOUTHEASTERN MASSACHUSETTS, IN RHODE ISLAND, AND IN EASTERN CONNECTICUT.

REPORT OF CAPT. W. H. BIXBY, CORPS OF ENGINEERS, OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1894, WITH OTHER DOCUMENTS RELATING TO THE WORKS.

IMPROVEMENTS.

1. Harbor of refuge at Hyannis, Mass.
2. Harbor of refuge at Nantucket, Mass.
3. Marthas Vineyard, inner harbor at Edgartown, Mass.
4. Harbor at Vineyard Haven, Mass.
5. Wareham Harbor, Massachusetts.
6. New Bedford Harbor, Massachusetts.
7. Canapitsit Channel, Massachusetts.
8. Taunton River, Massachusetts.
9. Pawtucket River, Rhode Island.
10. Providence River and Narragansett Bay, Rhode Island.
11. Green Jacket Shoal, Providence River, Rhode Island.
12. Newport Harbor, Rhode Island.
13. Harbor of refuge at Point Judith, Rhode Island.
14. Harbor of refuge at Block Island, Rhode Island.
15. Pawcatuck River, Rhode Island and Connecticut.
16. Harbor of refuge at Stonington, Conn.
17. Removing sunken vessels or craft obstructing or endangering navigation.

UNITED STATES ENGINEER OFFICE,
Newport, R. I, July 6, 1894.

GENERAL: I have the honor to submit herewith annual reports on the river and harbor works under my charge at the end of the fiscal year ending June 30, 1894.

In the work of this year this office has been assisted by Lieut. W. W. Harts, Corps of Engineers, and by Assistant Engineers Edward Parrish and John H. Rostock.

Very respectfully, your obedient servant,

W. H. BIXBY,
Captain, Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

C 1.

HARBOR OF REFUGE AT HYANNIS, MASSACHUSETTS.

The harbor of Hyannis lies on the south shore of the peninsula of Cape Cod, about 15 miles to the westward of the heel of the cape, and is an important harbor of refuge. (For map, see p. 592, Annual Report of 1884.)

The mean rise and fall of the tide is about 3¾ feet.

Original condition.—Before improvement it was an open roadstead, exposed to southerly storms, with depths varying from 10 to 20 feet in the inner harbor.

In the years 1827–1838 a breakwater of riprap granite, 1,170 feet long was constructed, covering an anchorage of about 175 acres, the entrance to which had a depth of about 15½ feet. In the years 1852–1882 extensive repairs were made in increasing the width of its base and the size of the stone forming its sides and top. About $124,000 was spent on this work, completed in 1882.

At the adoption of the present project the 15.5 feet depth anchorage covered only about 47 acres, and the 36 additional acres to be dredged carried an average of about 12 feet depth of water at low water.

Plan of improvement.—The present approved project, that of 1884, provides for the dredging to 15.5 feet depth at low water of about 34 acres of shoal area north of the existing breakwater, so as to increase the deep-water harborage by that amount; all at a total cost estimated in 1884 at $45,743.20 (including $81.20 left over from a former project).

A plan of the works may be found at p. 560, Annual Report of the Chief of Engineers for 1885, and p. 804 of 1893; and further information at p. 621 of 1885.

Appropriations.—Upon the present project appropriations have been made as follows: On hand 1884, $81.20; 1886, $10,000; 1888, $10,000; 1890, $8,000; 1892, $6,000. Totals up to June 30, 1893, $34,081.20.

Amount expended and results to June 30, 1893.—The total amount expended on the present project (including $66 of outstanding liabilities) up to June 30, 1893, was $28,609.23, by which 13 acres out of 36 had been dredged.

Operations during the past fiscal year.—Value of United States plant, $6,930. Including $147.44 of outstanding liabilities on June 30, 1894, the expenses of the year were $4,963.90.

By indorsement of August 19, the time of commencing contract work was extended until October 10, 1893, thus extending the time of completion until March 10, 1894. Upon special application of the contractor, approved by department indorsement of January 5, the time of completing contract was further extended to May 10, 1894. By department indorsement of May 1 this time was further extended to June 10, 1894. The commencement of work at this place was delayed partly by the contractor choosing to finish the New Bedford work first, and partly by the severe weather of December, January, and February. Dredging was finally commenced by the contractor at this place in April and completed on June 8, 1894; by which 21,880 cubic yards of sand were removed from 10,545 feet length and 25 feet width of cutting and to 15.5 feet depth at low water, resulting in an addition of about 6.1 acres to the anchorage basin. Further dredging must await further appropriations.

This work was in the local charge of Mr. Edward Parrish as assistant engineer, with Mr. C. O. Abel as inspector.

Work required to complete the existing project.—The work required to complete the existing project is the completion of the dredging to a depth of 15½ feet over 16 acres more in the area limited on the west by a line running due north from the western end of the breakwater, and on the north by a line running parallel to the breakwater, and distant 500 feet from it, leaving a berm of 100 feet along its northern side.

Operations contemplated for the fiscal year ending June 30, 1895.—It is proposed to apply the balance on hand, and the next appropriations, toward the completion of the anchorage area inside the breakwater.

Steam	
Passenger boats	[illegible]
Fishing	[illegible]
Tugs	[illegible]
Pleasure boats	[illegible]
Sail	
Freight	[illegible]
Fishing boats	[illegible]
Pleasure boats, large	[illegible]
Pleasure boats, small	[illegible]

C 2.

HARBOR OF REFUGE AT NANTU

Nantucket Harbor is the only larg
between the harbors of Marthas Vineya
town) and Provincetown, a distance of

harbor of Hyannis, on the other (the north) side of Nantucket Sound. The navigation of this sound is intricate and dangerous by reason of numerous shoals. Nantucket Harbor has deep water inside, and the object of the improvement is to make it a harbor of refuge for vessels plying between ports north and south of Cape Cod, estimated to be 50,000 annually. In the memorial to Congress, on which the first appropriation for this harbor of refuge was based, it was stated that more than 500 vessels had been wrecked in the vicinity of the island. (For map of harbor see p. 423, Annual Report of 1880, and p. 576 of Report of 1885.)

The mean rise and fall of the tide is about 3 feet.

Original condition.—At the adoption of the present project no jetties existed, and the channel entrance was barred by a shoal of 1.5 miles width, on which there was only 6 feet depth of water at low tide, the channel being very crooked and subject to changes in location.

Plan of improvement.—The present approved project, that of 1880, as modified in 1885, provides for the construction of two jetties as training walls, one on each side of the harbor entrance, planned so as to allow the tidal current to assist in scouring out and maintaining a good channel, and for the completion of the work by dredging where necessary to obtain a depth of from 12 to 15 feet at low water in this channel, all at a total cost estimated in 1885 at $375,000.

A plan of the works may be found at p. 578, Annual Report of the Chief of Engineers for 1885, and p. 806 of 1893; and further information at p. 436 of 1880, p. 544 of 1881, p. 595 of 1884, and pp. 563, 575, 578 of 1885.

Appropriations.—Upon the present project appropriations have been made as follows: 1880, $50,000; 1881, $25,000; 1882, $25,000; 1884, $10,000; 1886, $15,000; 1888, $20,000; 1890, $25,000; 1892, $25,000. Totals up to June 30, 1893, $195,000.

Amount expended and results to June 30, 1893.—The total amount expended on the present project (including $599.05 outstanding liabilities) up to June 30, 1893, was $172,045.22, by which the west jetty had been built to 3,955 feet length with full height; the east jetty had been built to 834 feet length with full height; then came a gap of 160 feet, and then 1,300 feet length raised to half-tide level, completing about half the needed work.

Operations during the past fiscal year.—Value of United States plant, $6,490. Including $3,570.96 of outstanding liabilities on June 30, 1894, the expenses of the year were $6,391.87.

During the year general preparations and repair of plant, including overhauling of jetty light, and later, the replacing of both the lantern and staff, which during the past winter had been carried away by ice and lost. Informal bids for placing stone in the jetties were received, and contract entered into with Messrs. S. & E. S. Belden, of Hartford, Conn., under date of April 16 (approved by the Chief of Engineers on April 21), at $1.85 per ton of 2,000 pounds in place in the east jetty, and $2 per ton of 2,000 pounds in place in the west jetty; work to be commenced on or before June 30, and completed on or before December 31, 1894. Work was actually commenced by the contractor on May 30, and was in progress at the end of the year; 825 tons of core stone and 590 tons of facing stone being placed in the east jetty, thereby extending it by 420 feet; and 575 tons of facing stone being placed on the west jetty, thereby leveling it up to about 100 feet from the shore end.

A light has been maintained on the west jetty during the year.

This work was in the local charge of Mr. Edward Parrish as assistant engineer, with Mr. C. O. Abel as inspector.

Work required to complete the existing project.—The work required to complete the existing project is the extension of the east jetty, the raising of the west jetty in some places, and the excavation by dredging of so much of the channel as may not be excavated by tidal scour.

Operations contemplated for the fiscal year ending June 30, 1895.—The work has been much delayed heretofore by the scour around the end of the jetty, making it necessary to build it in 15 feet of water instead of in 5. According to the present plan it is proposed to build up a considerable length of the jetty to the half-tide level before completing it to the full cross section. The channel appears to be moving continually to the eastward and deepening slightly from year to year.

It is proposed to apply the balance on hand and the next appropriation to the further construction of the east jetty and raising low places in the west jetty, together with a little dredging, if necessary.

Nantucket is in the Nantucket collection district and is a port of entry. There was $60 revenue collected in the last calendar year. The value of the harbor is mainly as a harbor of refuge. The nearest light-houses are Nantucket Cliff and Brant Point lights. The nearest fortification is the fort at Clark Point, New Bedford, Mass.

Money statement.

July 1, 1893, balance unexpended		$22,954.78
June 30, 1894, amount expended during fiscal year		3,419.96
July 1, 1894, balance unexpended		19,534.82
July 1, 1894, outstanding liabilities	$3,570.96	
July 1, 1894, amount covered by uncompleted contracts	13,407.25	
		16,978.21
July 1, 1894, balance available		2,556.61
Amount (estimated) required for completion of existing project		180,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896		100,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

COMMERCIAL STATISTICS.

The commerce arriving and leaving Nantucket Harbor, Massachusetts, by water during the calendar year ending December 31, 1893, is estimated as follows, based mainly upon reports received from Mr. Joseph W. Clapp, collector of customs, Nantucket, Mass.:

Class of goods.	Exports.	Imports.	Total.	Tonnage.
Fish, oysters, etc	$15,000	$2,000	$17,000	400
Live stock and products		4,000	4,000	15
Vegetables and truck		12,000	12,000	600
Grain and forage		30,000	30,000	600
Rice		10,000	10,000	60
Tobacco		40,000	40,000	70
Fertilizers		12,000	12,000	600
Naval stores		1,000	1,000	10
Lumber and products		16,000	16,000	1,500
Coal, minerals, and products		45,000	45,000	7,500
Machinery and hardware		15,000	15,000	100
General merchandise		115,000	115,000	1,500
Sundries		75,000	75,000	2,000
Total	15,000	377,000	392,000	14,955

Gain over last year, about 1,000 tons; transportation lines established during the year, none.

The passage of vessels through this waterway is estimated as follows (each entrance and departure together, being counted as one passage):

Character or class of service.	Number.	Average draft.	Average tonnage.
Steam:		*Feet.*	*Tons.*
Freight and passenger	480	8	500
Freight mainly	3		
Tugs	1	5	50
Pleasure boats	10		
Sail:			
Freight	3	8	500
Passenger schooners	7		
Fishing boats	1	4	10
Pleasure boats, large	21	4	6
Pleasure boats, small	20	5	3.5

C 3.

IMPROVEMENT OF MARTHAS VINEYARD INNER HARBOR AT EDGARTOWN, MASSACHUSETTS.

The inner harbor at Edgartown lies in the northern part of the waterway or strait that separates Chappaquiddick Island from the east end of Marthas Vineyard. It extends southward about 1½ miles from Chappaquiddick Point, opposite Edgartown, and averages about one-fifth of a mile in width.

This harbor is so completely landlocked as to form a safe harbor of refuge for small vessels, but the contracted width of the entrance and the resulting velocity of the tidal currents make it difficult to pass through. (For map of this harbor see House Ex. Doc. No. 59, of Fifty-first Congress, first session.)

Original condition.—At the adoption of the present project the middle-ground shoal carried only about 6 feet depth of water, and was a very troublesome obstruction.

Plan of improvement.—The present approved project, that of 1889, provides for the removal to 10 feet depth at low water of a "middle-ground" shoal in the central part of the inner harbor; all at a total cost estimated in 1893 at $7,000.

A description of the works may be found at p. 588, Annual Report of the Chief of Engineers for 1890, and a plan of the same in House Ex. Doc. No. 59, of the Fifty-first Congress, first session, and p. 810, Annual Report of 1893; and other special information at p. 809, Annual Report of 1893.

Appropriations.—Under the present project appropriations have been made as follows: 1890, $2,000; 1892, $2,500. Total up to June 30, 1893, $4,500.

Amount expended and results to June 30, 1893.—The total amount expended on the present project (including $126.54 outstanding liabilities) up to June 30, 1893, was $4,394.15, by which about three-quarters of the shoal had been dredged to full depth.

Operations during the past fiscal year.—Value of United States plant, $160. Including $6.70 of outstanding liabilities on June 30, 1894, the expenses of the year were $104.44.

During the year, general office work only, including preparations for future work. Further dredging awaits further appropriations.

This work was in the local charge of Mr. J. H. Rostock as assistant engineer.

Work required to complete the existing project.—The work required to complete the existing project is the excavation of the remaining quarter of the middle ground to a depth of 10 feet at mean low water.

Operations contemplated for the fiscal year ending June 30, 1895.—It is proposed to complete the project.

Edgartown is in the Edgartown collection district and is a port of entry. The amount of revenue collected there during the last calendar year was $653.87; the nearest light-house is the Edgartown Light; the nearest fortification is the fort at Clark Point, New Bedford, Mass.

Money statement.

July 1, 1893, balance unexpended	$232.39
June 30, 1894, amount expended during fiscal year	224.28
July 1, 1894, balance unexpended	8.11
July 1, 1894, outstanding liabilities	6.70
July 1, 1894, balance available	1.41
Amount (estimated) required for completion of existing project	2,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	2,500.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

COMMERCIAL STATISTICS.

The commerce arriving and leaving Edgartown, Marthas Vineyard, Mass., by water during the calendar year ending December 31, 1893, is estimated as follows, based mainly upon reports received from Mr. C. H. Marchant, collector of customs, Edgartown, Mass.:

Class of goods.	Exports.	Imports.	Total.	Tonnage.
Fish, oysters, etc	$75,500	$2,700	$78,200	2,000
Live stock and products	6,800	16,700	23,500	150
Grain and forage		97,000	97,000	3,000
Rice		100	100	1
Tobacco		50,000	50,000	600
Cotton and products		34,500	34,500	30
Fertilizers		1,500	1,500	75
Coal, minerals and products	1,200	23,100	24,300	4,000
Machinery and hardware		15,000	15,000	600
General merchandise	9,000	533,250	542,250	7,000
Sundries	6,000	6,000	12,000	800
Total	98,500	779,850	878,350	18,256

Gain over last year, none. Transportation lines established during the year, none reported.

The passage of vessels through this waterway is estimated as follows (each entrance and departure together being counted as one passage):

Character or class of service.	Number.	Average draft.	Average tonnage.
Steam:		*Feet.*	*Tons.*
Freight and passenger	240	9	345
Fishing	30	11	120
Tugs	105	9.5	80
Pleasure boats	125	8	100
Sail:			
Freight	515	12	150
Fishing boats	10,600	3.5	9
Pleasure boats, large	660	5	11
Pleasure boats, small	2,500	2	3

C 4.

IMPROVEMENT OF VINEYARD HAVEN HARBOR, MASSACHUSETTS.

Vineyard Haven is a deep indentation in the northern shore of the island of Marthas Vineyard, on the southern side of Vineyard Sound. It is triangular in form and faces the northeast. The width of the mouth of the harbor, or the distance between the points of land on the east and west sides of the entrance known as East Chop and West Chop, is about 1¼ miles; and from a line connecting the chops to the narrow southerly end of the harbor, at which is situated the town of Vineyard Haven, the distance is about 1¾ miles. The entire area of the harbor between the shore lines is about 949 acres, of which some 657 acres have a depth of not less than 15 feet. The mean rise and fall of the tide is 1.7 feet.

Original condition.—At the mouth of the harbor the wearing away of the chops by the action of the waves in storms had been noted for many years. The former site of a light-house on West Chop had entirely disappeared. The débris was carried by the current into the harbor, where it formed shoals, which were gradually impairing the anchorage capacity, especially in the upper part of the harbor. (For map of harbor see p. 580 of Annual Report of 1887.)

Plan of improvement.—The present approved project, that of 1887, as modified in 1889, provides for the protection of the "chops" (or headlands) from erosion, and the intervening harbor from being filled by the eroded material; the whole to be done by means of stone sea walls and jetties, to be built along the beach in front of the bluffs at both headlands, all at a total cost estimated in 1889 at $60,000.

A description of the work may be found at p. 594, Annual Report of the Chief of Engineers for 1882, p. 577 of 1887, and p. 612 of 1889, and a map of the same at p. 812 of 1893.

Appropriations.—Upon the present project appropriations have been made as follows: 1888, $25,000; 1890, $10,000; 1892, $7,500. Total up to June 30, 1893, $42,500.

Amount expended and results to June 30, 1893.—The total amount expended on the present project (including $219.05 outstanding liabilities) up to June 30, 1893, was $35,993.89, by which there had been built a sea wall of 450 feet length, and a jetty of 50 feet length, at the East Chop; and a sea wall of 400 feet length, 3 jetties of from 80 to 296 feet length, a wharf and a short breakwater of 60 feet length, at the West Chop; completing about half the needed work.

Operations during the past fiscal year.—Value of United States plant, $3,420. Including $457.12 of outstanding liabilities on June 30, 1894, the expenses of the year were $4,858.74.

By letter from office of Chief of Engineers, dated August 7, 1893 (contractor's time having expired), the Engineer officer was authorized to continue with the contractor in open market, at the same rates as those of the original contract. Work was commenced by the contractor in August and continued until December, when stopped on account of the severe winter weather; by which 608 tons of heavy stone and 467 tons of light stone were placed in position in about 800 feet length of sea walls and jetties at the West Chop, completing such work at this chop for the present, and 386 tons of heavy stone and 215 tons of light stone were put in position in about 600 feet length of sea wall and jetties at the East Chop. Preparations are being made for resumption and completion of work.

This work was in the local charge of Mr. Edward Parrish as superintendent, with Mr. S. B. Pendleton as inspector.

Work required to complete the existing project.—The work required to complete the existing project is the completion of these systems of jetties and sea walls at both chops.

Operations contemplated for the fiscal year ending June 30, 1895.—It is proposed to complete the project.

Vineyard Haven is in the Edgartown collection district. Edgartown is the nearest port of entry. The amount of revenue collected at Edgartown in the last calendar year was $653.87. The nearest light-houses are those on East and West Chops. The nearest fortification is the fort at Clark Point, New Bedford, Mass.

Money statement.

July 1, 1893, balance unexpended		$6,725.16
June 30, 1894, amount expended during fiscal year		4,620.67
July 1, 1894, balance unexpended		2,104.49
July 1, 1894, outstanding liabilities	$457.12	
July 1, 1894, amount covered by uncompleted contracts	977.60	
		1,434.72
July 1, 1894, balance available		669.77
Amount (estimated) required for completion of existing project		17,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1896		17,500.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

COMMERCIAL STATISTICS.

The commerce arriving and leaving Vineyard Haven Harbor, Massachusetts, by water during the calendar year ending December 31, 1893, is estimated as follows, based mainly upon reports received from Mr. Edward C. Lord, Vineyard Haven, Mass.:

Class of goods.	Exports.	Imports.	Total.	Tonnage.
				Tons.
Fish, oysters, etc	$36,000	$300	$36,300	500
Live stock and products	3,500	40,000	43,500	200
Vegetables and truck	300	5,000	5,300	15
Grain and forage		45,000	45,000	2,500
Rice		4,000	4,000	45
Tobacco		10,000	10,000	15
Cotton and products		10,000	10,000	20
Fertilizers		2,000	2,000	50
Lumber and products		25,000	25,000	2,500
Coal, minerals, and products		40,000	40,000	8,000
Machinery and hardware		5,000	5,000	100
General merchandise		600,000	600,000	5,000
Sundries		10,000	10,000	1,500
Total	39,800	796,300	836,100	20,445

Gain over 1891, about 4,000 tons, or $165,000. Transportation lines established during the year, none.

The passage of vessels through this waterway is estimated as follows (each entrance and departure together being counted as one passage):

Character or class of service.	Number.	Average draft.	Average tonnage.
Steam:		*Feet.*	*Tons.*
Freight and passenger	1,500	10	600
Freight mainly	200	16	1,000
Passenger mainly	50	12	900
Fishing	10	10	200
Tugs	500	11	100
Pleasure boats	200	9	200
Sail:			
Freight	7,000	15	500
Fishing boats	300	10	150
Pleasure boats, large	500	10	100
Pleasure boats, small	200	5	10

C 5.

IMPROVEMENT OF WAREHAM HARBOR, MASSACHUSETTS.

This harbor is an estuary at the head of Buzzards Bay. The object of the improvement is to deepen and widen the channel leading from Buzzards Bay to Wareham, the industries of which (and of several towns in the vicinity with which it is connected by rail) are chiefly the manufacture of iron, whose heavy materials and supplies must be transported by water. The commerce of Wareham is carried on in sailing vessels, which require a wide channel suited to beating across the wind.

Another object of the improvement is the raising of Long Beach, over which the sands from the bay were washed into the harbor. The mean rise and fall of the tide is 4 feet.

Original condition.—Before improvement the ruling depth in the harbor was about 7 feet at mean low water, and the channel was narrow and very crooked. Long Beach, a narrow sand spit at the mouth of the harbor, was washed and abraded by the waves and currents at high water, and the material was carried into and shoaled the channel inside.

Between 1871 and 1875 $40,000 was appropriated to obtain a channel depth of 10 feet in the lower harbor and 9 feet in the upper harbor, and to partially protect Long Beach by brush and stone work. This work was finished in 1876.

At the adoption of the present project the headland of Long Beach was wearing off and the adjacent parts of the channel and harbor were shoaling; the channel depth was limited to 9 feet at low water, this channel being narrow and crooked.

Plan of improvement.—The present approved project, that of 1880, provides for the deepening and widening of the channel from Buzzards Bay to Wareham so as to obtain 9 feet depth at low water over 250 feet width from the entrance up to Barneys Point, thence the same depth over 350 feet width up to the lower wharves of the city, and thence the same depth and from 200 to 100 feet width opposite the city front; and for the raising and protecting of Long Beach (the eastern headland of the entrance) so as to prevent the erosion of this beach and the shoaling of the adjacent parts of the channel and harbor; all at a total cost estimated, in 1887 at $56,236.

A plan of the works may be found at p. 586, Annual Report of the Chief of Engineers for 1885, and p. 814 of 1893; and further information at p. 553 of 1881, and p. 80, Part I of 1882.

Appropriations.—Upon the present project appropriations have been made as follows: 1881, $10,000; 1882, $5,000; 1884, $10,000; 1886, $15,000; 1888, $4,000; 1890, $5,000; 1892, $7,236. Total up to June 30, 1893, $56,236.

Amount expended and results to June 30, 1893.—The total amount expended on the present project (including $952.55 outstanding liabilities) up to June 30, 1893, was $52,192.80, by which the channel had been deepened to half width and full depth of 9 feet in its upper portion, and to less width in its lower portions; and the sand spit had been partly protected by catch-sand fences and brush and stone work.

Operations during the past fiscal year.—Value of United States plant, $5,550. Including $66.74 of outstanding liabilities on June 30, 1894, the expenses of the year were $3,635.16.

During the year the minor survey was completed. Dredging by the Government plant, in progress at commencement of year, was continued until August 25, when stopped by exhaustion of funds; by which 35,874 cubic yards of mud, 1,972 yards of sand, stone and gravel, and 4 cubic yards of bowlders were removed from 6,118 feet length and 33 to 40 feet width of cutting, and to at least 10 feet depth at low water.

Further dredging awaits further appropriations.

This work was in local charge of Mr. J. H. Rostock as assistant engineer, with Mr. G. Callin as overseer.

Work required to complete the existing project.—The work required to complete the existing project is the excavation of the channel to its full width and depth at its upper and lower ends.

Operations contemplated for the fiscal year ending June 30, 1895.—It is proposed to apply the balance of funds on hand and the next appropriation toward the completion of the channel.

Wareham is in the New Bedford collection district. New Bedford is the nearest port of entry. The amount of revenue collected at New Bedford in the last calendar year was $192,794.10. The nearest light-houses are Bird Island and Wing Neck lights. The nearest fortification is the fort at Clark Point, New Bedford, Mass.

Money statement.

July 1, 1893, balance unexpended	$4,995.75
June 30, 1894, amount expended during fiscal year	4,520.97
July 1, 1894, balance unexpended	474.78
July 1, 1894, outstanding liabilities	66.74
July 1, 1894, balance available	408.04

COMMERCIAL STATISTICS.

The commerce arriving and leaving Wareham Harbor, Massachusetts, by water during the calendar year ending December 31, 1893, is estimated as follows, based mainly upon reports received from Mr. Alden Besse, Wareham, Mass.:

Class of goods.	Exports.	Imports.	Total.	Tonnage.
				Tons.
Fish, oysters, shells, etc	$30,000	$8,000	$38,000	8,000
Live stock and products	1,000	42,000	43,000	400
Vegetables and truck	240,000	12,000	252,000	3,250
Grain and forage	80,000	210,000	290,000	13,000
Lumber and products	5,000	60,000	65,000	3,000
Coal, minerals, and products	13,675	515,000	528,675	68,000
Machinery and hardware	750,000	50,000	800,000	20,000
General merchandise	43.000	230,000	273,000	1,800
Sundries	5,000	40,000	45,000	400
Total	1,167,675	1,167,000	2,334,675	117,850

Gain over last year, about 2,500 tons; transportation lines established during the year, none.

The passage of vessels through this waterway is estimated as follows (each entrance and departure together being counted as one passage):

Character or class of service.	Number.	Average draft.	Average tonnage.
Steam:		*Feet.*	*Tons.*
Freight mainly	30	8	300
Tugs	40	10	50
Barges, freight	18	10	500
Sail:			
Freight	150	12	250
Pleasure boats	200		

C 6.

IMPROVEMENT OF NEW BEDFORD HARBOR, MASSACHUSETTS.

New Bedford Harbor is an estuary of Buzzards Bay and is the port of the cities of New Bedford and Fairhaven, Mass. New Bedford is an important port of entry. It is largely interested in manufactures, those of cotton predominating, and has an extensive commerce in addition to its whale fisheries. The population of New Bedford and Fairhaven in 1888 was about 38,000.

The object of the improvement is to provide a channel 18 feet deep at mean low water.

The mean rise and fall of the tide is about 4.2 feet.

Original condition.—Before improvement the channel had a ruling depth of about 12½ feet at mean low water.

As early as 1839 some little dredging was done for the improvement of the harbor. The increase of depth obtained, however, was only 2 feet, and the cut but 30 feet wide. A survey of the harbor was made in 1852, but a definite project for its improvement was not made until 1874. The project provided for a channel 200 feet wide and 15 feet deep at mean low water from the deep water just above Palmer Island to the wharves at New Bedford. This project was modified in 1877, increasing the width of channel to 300 feet, and by means of appropriations made in 1875-'76, amounting to $20,000, this project was completed in 1877. Since that time vessels of larger draft have been employed in the harbor, and vessels of 15 feet draft not only now touch the bottom in this channel, but in the channel below Palmer Island, at points not included in the former improvement.

At the adoption of the present project the channel was winding, and only about 15 feet deep.

Plan of improvement—The present approved project, that of 1887, provides for the deepening, widening, and straightening of the channel from Buzzards Bay to New Bedford, so as to obtain 18 feet depth at low water over 200 feet width and over its entire length; all at a total cost estimated in 1887 at $35,000.

A description of the works may be found at p. 514, Annual Report of the Chief of Engineers for 1888, and a plan of the same in House Ex. Doc. No. 86 of the Fiftieth Congress, first session; and at p. 816, Annual Report of 1893.

Appropriations.—Upon the present project appropriations have been made as follows: In 1888, $10,000; 1890, $10,000; 1892, $7,500; total up to June 30, 1893, $27,500.

Amount expended and results to June 30, 1893.—The total amount expended on the present project (including $38.56 outstanding liabilities) up to June 30, 1893, was $20,302.43, by which the straight channel had been completed on its western side to 15 feet depth with 80 feet width over its entire length; and a slightly crooked channel of 80 feet width with 18 feet depth also existed over the same distance, wandering a little from the projected channel.

Operations during the past fiscal year.—Value of United States plant, $3,320. Including $51.80 outstanding liabilities on June 30, 1894, the expenses of the year were $6,568.81.

By indorsement of August 19, 1893, the time of commencing contract work was extended until October 10, 1893, thus extending the time of completion until March 10, 1894. Dredging was commenced by the contractor in October and completed in December, 1893; by which 30,303 cubic yards of material was removed from 9,380 feet length and from 20 to 25 feet width of cutting, and to 18 feet depth at low water, thus completing the channel from deep water above Palmers Island to the vicinity of the wharves of New Bedford and to its full width of 200 feet and depth of 18 feet at low tide, excepting for a distance of about 150 feet near its eastern end, where the width was 175 feet, and excepting at a small shoal spot near the western end, which lacked about 1 foot of the full depth. Authority was received in February for the hire in open market of from 2,000 to 3,000 cubic yards of additional dredging, in order to remove these few remaining shoal spots; and during March, 1,108 cubic yards of material was excavated from 310 feet length and from 25 feet width of cutting, and to 18 feet depth at low water, thus completing all work upon the uppermost reach of the harbor.

Further dredging awaits further appropriations.

This work was in the local charge of Mr. Edward Parrish as assistant engineer, with Mr. C. O. Abel as inspector.

Work required to complete the existing project.—The work required to complete the existing project is the widening of the channel from Palmers Island to the 11-foot bank and the removal of a few shoal spots between the 11-foot bank and the Butler Flats, the southern end of the projected channel.

Operations contemplated for the fiscal year ending June 30, 1895.—It is proposed to complete the project.

New Bedford Harbor is in the New Bedford collection district, and is a port of entry. The amount of revenue collected in the last calender year was $192,794.10. The nearest light-houses are Clark Point Light and the lights in New Bedford Harbor. The nearest fortification is fort at Clark Point, Mass.

Money statement.

July 1, 1893, balance unexpended	$7,236.13
June 30, 1894, amount expended during fiscal year	6,555.57
July 1, 1894, balance unexpended	680.56
July 1, 1894, outstanding liabilities	51.80
July 1, 1894, balance available	628.76
Amount (estimated) required for completion of existing project	7,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	7,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

COMMERCIAL STATISTICS.

The commerce arriving and leaving New Bedford, Mass., by water during the calendar year ending December 31, 1893, is estimated as follows, based mainly upon reports received from Mr. James Taylor, collector of customs. New Bedford, Mass.

Class of goods.	Exports.	Imports.	Total.	Tonnage.
				Tons.
Fish, oysters, etc	$215,000		$215,000	5,500
Live stock and products	21,000		21,000	200
Vegetables and truck	61,800		61,800	650
Grain and forage	2,500	$480,000	482,500	21,000
Tobacco	3,000		3,000	5
Cotton and products	4,200	2,640,000	2,644,200	13,500
Lumber and products	11,800	350,000	361,800	2,500
Coal, minerals, and products	2,000	1,800,000	1,802,000	450,000
General merchandise	7,300,000	3,000,000	10,300,000	103,000
Sundries		1,000,000	1,000,000	33,000
Total	7,621,300	9,270,000	16,891,300	629,355

Gain over last year, none; transportation lines established during the year, none reported.

The passage of vessels through this waterway is estimated as follows (each entrance and departure together being counted as one passage):

Character or class of service.	Number.	Average draft.	Average tonnage.
Steam:		Feet.	Tons.
Freight and passenger	700	8	560
Freight mainly	400	17	1,000
Passenger mainly	500	8	60
Tugs	700	8	50
Pleasure boats	250		
Sail:			
Freight	1,600	13	800
Fishing boats	550	5	10
Pleasure boats, large	400		
Pleasure boats, small	1,000		

C 7.

IMPROVEMENT OF CANAPITSIT CHANNEL, MASSACHUSETTS.

This water-way lies about 20 miles south of New Bedford, running between the islands of Cuttyhunk and Nashawena, and connecting the waters of Vineyard Sound and Buzzards Bay.

The object of the improvement is to make this channel safe for the use of light-draft sailboats, and also especially of the surf boats belonging to the life-saving station of this dangerous locality.

Original condition.—Before improvement the sand shoals, and especially the numerous bowlders, made this passage specially dangerous to the life-saving station boats and other shallow-draft row and sail boats.

Plan of improvement.—The present approved project, that of 1891, provides for the widening and deepening of the present channel from Vineyard Sound to the ocean between the islands of Nashawena and Cuttyhunk, Massachusetts, so as to secure a depth of 6 feet at low water, with a least width of 250 feet over its entire length, all at a total cost estimated in 1893 at $9,800.

A description of the work may be found at p. 645, Annual Report of the Chief of Engineers for 1892, and a plan of the same in House Ex. Doc. No. 59, of the Fifty-second Congress, first session; and at p. 820 of Annual Report of 1893; and further special information on p. 820, Annual Report of 1893.

Appropriations.—Upon the present project only one appropriation has been made, that of 1892 for $4,800.

Amount expended and results to June 30, 1893.—The total amount expended on the present project (including $2,248.32 of outstanding liabilities) up to June 30, 1893, was $3,787.86; by which a channel of 66 feet width and about 5 feet depth at low water was cut entirely through from Buzzards Bay to Vineyard Sound.

Operations during the past fiscal year.—Value of United States plant, $760. Including $41.01 outstanding liabilities on June 30, 1894, the expenses of the year were $933.45.

In July a final inspection was made of the season's work, and six large bowlders were removed by 60 pounds dynamite in 7 charges, leaving nothing of these obstructions above the general bottom of the dredged channel. Since then work has been mainly that of accounts and reports, and minor repair of plant.

Further dredging awaits further appropriations.

This work has been in the local charge of Mr. J. H. Rostock as assistant engineer, with Mr. Theo. McMahon as overseer.

Work required to complete the existing project.—The work yet to be done is to deepen the 66 feet width channel by about 1 foot, and the remaining 83 to 283 feet width of channel by about 2 feet.

Operations contemplated for the fiscal year ending June 30, 1895.—It is proposed to complete the project.

Money statement.

July 1, 1893, balance unexpended	$3,260.46
June 30, 1894, amount expended during fiscal year	3,140.76
July 1, 1894, balance unexpended	119.70
July 1, 1894, outstanding liabilities	41.01
July 1, 1894, balance available	78.69
Amount (estimated) required for completion of existing project	5,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	5,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

COMMERCIAL STATISTICS.

The commerce arriving and leaving Cuttyhunk, Mass., by water during the calendar year ending December 31, 1893, is estimated as follows, based mainly upon reports received from Mr. D. P. Bosworth, keeper life-saving station, Cuttyhunk, Mass.

Class of goods.	Exports.	Imports.	Total.	Tonnage.
				Tons.
Fish, oysters, etc	$15,000		$15,000	250
Live stock and products	602	$588	1,190	10
Vegetables and truck	120		120	4
Grain and forage		680	680	25
Tobacco		1,700	1,700	2
Cotton and products		400	400	1
Fertilizers		60	60	2
Naval stores		600	600	2
Lumber and products		845	845	70
Coal, minerals, and products		350	350	50
Machinery and hardware		200	200	2
General merchandise	2,500	22,500	25,000	250
Sundries	600		600	40
Total	18,822	27,923	46,745	708

Gain over last year, about 10 tons, or $20,000. Transportation lines established during the year—none reported.

The passage of vessels through this waterway is estimated as follows (each entrance and departure together being counted as one passage):

Character or class of service.	Number.	Average draft.	Average tonnage.
Steam:		*Feet.*	*Tons.*
Freight and passenger	150	6	60
Tugs	10	8	75
Pleasure boats	100	6	30
Sail:			
Fishing boats	1,250	4	6
Pleasure boats, large	100	7	80
Pleasure boats, small	300	3	

C 8.

IMPROVEMENT OF TAUNTON RIVER, MASSACHUSETTS.

This river rises in Norfolk County, Mass., and empties in Mount Hope Bay, a part of Narragansett Bay. It is about 44 miles in length.

The object of the improvement is to deepen and widen the channel so that vessels of 11 feet draft can at high water go up to the city of Taunton, which for its extensive manufactures requires large quantities of coal, iron, clay, moldings, sand, and other heavy articles. The rise and fall of the tide before improvement was 5¼ feet at Dighton and 3.4 feet at Taunton.

Original condition.—In its original condition the channel was narrow and obstructed by bowlders, and from Berkley bridge to Taunton its depth was not, in places, more than 5 feet at mean high water. A vessel of 30 tons burden was as large as could go up to Taunton.

From 1870 to 1879 $63,000 was appropriated to secure a depth of 9 feet at high water, up to the head of navigation. This work was completed in 1879. (See p. 375, Annual Report of 1880.)

At the adoption of the present project, the channel was limited to 9 feet at high water, and was too narrow and too much obstructed by bowlders for easy navigation by the craft making use of it.

Plan of improvement.—The present approved project, that of 1880, provides for the widening and deepening of the river so as to secure a channel of at least 12 feet depth at high water, with 100 feet width from its mouth up to Berkley bridge (above Dighton); thence 12 feet depth with 80 feet width (100 feet width at bends) up to Briggs Shoal; thence 11 feet depth with 80 feet width up to the ship yard; thence 11 feet depth with 60 feet width up to the Weir bridge, Taunton; all at a total cost estimated in 1893 at $125,000.

A plan of the works may be found at p. 606, Annual Report of the Chief of Engineers for 1884, and p. 824 of 1893; and a later more detailed plan in House Ex. Doc. No. 86, of the Fiftieth Congress, first session; and further information at p. 373 of the Annual Report of 1880, p. 519 of 1888, and p. 823 of 1893.

Appropriations.—Upon the present project appropriations have been made as follows: 1880, $17,500; 1881, $25,000; 1882, $25,000; 1884, $26,500; 1890, $7,000; 1892, $7,000. Total up to June 30, 1893, $108,000.

Amount expended and results to June 30, 1893.—The total amount expended on the present project (including $51.01 outstanding liabilities) up to June 30, 1893, was $107,996.23, by which a large part of the proposed work had been done; especially at the places most complained of by the vessels using this river.

Operations during the past fiscal year.—Value of United States plant, $820. Including $0.00 outstanding liabilities on June 30, 1884, the expenses of the year were $1.88.

During the past fiscal year, general office work and preparations for future work.

Further dredging awaits further appropriations.

This work was in local charge of Mr. Edward Parrish, as assistant engineer.

Work required to complete the existing project.—There remain to complete the existing project the widening and deepening of the channel at a few points and the removal of a small amount of ledge rock.

Operations contemplated for the fiscal year ending June 30, 1895.—It is proposed to complete the project.

Taunton River is in the Fall River collection district. Fall River is the nearest port of entry. The amount of revenue collected at Fall River in the last calendar year was $193,992.13. The nearest light-house is the Borden Flat light-house. The nearest fortification is Fort Adams, Newport Harbor, Rhode Island.

Money statement.

July 1, 1893, balance unexpended	$54.78
June 30, 1894, amount expended during fiscal year	2.89
July 1, 1894, balance unexpended	51.89
Amount (estimated) required for completion of existing project	17,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	17,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

COMMERCIAL STATISTICS.

The commerce arriving and leaving Taunton River, Massachusetts, by water during the calendar year ending December 31, 1893, is estimated as follows, based mainly upon reports received from Mr. J. S. Burns, Taunton, Mass.:

Class of goods.	Exports.	Imports.	Total.	Tonnage.
				Tons.
Grain and forage		$803,000	$803,000	35,500
Cotton and products		1,312,000	1,312,000	6,600
Lumber and products	$56,000	244,000	300,000	16,000
Coal, minerals, and products	150,000	1,320,000	1,470,000	289,000
General merchandise		700,000	700,000	7,000
Total	206,000	4,379,000	4,585,000	354,100

Gain over last year, none. Transportation lines established during the year, none.

The passage of vessels through this waterway is estimated as follows (each entrance and departure together being counted as one passage):

Character or class of service.	Number.	Average draft.	Average tonnage.
		Feet.	*Tons.*
Steam tugs	400	7	50
Barges, freight	200	9	500
Sail, freight	700	9	200

C 9.

IMPROVEMENT OF PAWTUCKET RIVER, RHODE ISLAND.

The navigable part of the Pawtucket (or Seekonk) River, an arm of Providence River, extends from Providence to Pawtucket, a city which in 1885 had a population of about 23,000 and extensive manufactures, depending largely on water transportation. The mean rise and fall of the tide is about 5 feet.

Original condition.—Before improvement the channel in the river was narrow and had a ruling depth of about 5 feet at mean low water.

Between 1867 and 1882 $52,000 were appropriated to dredge the channel to 75 feet width and 7 feet depth at low water. This work was completed in 1876.

At the adoption of the present project the channel was narrow and only about 7 feet deep.

Plan of improvement.—The present approved project, that of 1883, provides for the deepening of the river so as to secure a channel of at least 12 feet depth at low water, with 100 feet width from its mouth at Providence up to opposite Grant & Co.'s Wharf, at Pawtucket, and thence 12 feet depth with 40 feet width through a stone ledge for a short distance towards Pawtucket bridge; all at a total cost estimated in 1883 at $382,500.

A plan of the works may be found at page 608, Annual Report of the Chief of Engineers for 1884, and page 830 of 1893.

Appropriations.—Upon the present project appropriations have been made as follows: 1884, $50,000; 1886, $30,000; 1888, $35,000; 1890, $30,000; 1892, $35,000. Total up to June 30, 1893, $180,000.

Amount expended and results to June 30, 1893.—The total amount expended on the present project (including $28.34 outstanding liabilities) up to June 30, 1893, was $145,580.11, by which the shoalest places had been improved and about nine-tenths of the needed work done, securing a channel of about 12 feet depth with from 40 to 100 feet width (the greater portion being 100 feet wide) up to above the lower wharves of the city of Pawtucket.

Operations during the past fiscal year.—Value of United States plant, $13,910. Including $149.28 outstanding liabilities on June 30, 1894, the expenses of the year were $23,545.68.

Dredging was commenced by the contractor in August and completed in October; by which 32,975 cubic yards of the material were removed from 9,339 feet length and from 10 to 20 feet width of cutting and to 12 feet at low water, completing all contract work. In October authority was asked and received for the hire in open market of 6,000 cubic yards of additional dredging in order to complete the work in the manner provided for by existing approved projects, and an arrangement was made with Mr. E. Brainard, of New York, for such dredging at 32 cents per cubic yard, this work (6,000 cubic yards) being begun and completed in October. By letter of the 16th September, 1893, from the office of the Chief of Engineers, authority was received to allow the expenditure of about $4,000 for blasting by hired labor and purchase of materials in open market, and under this authority work by the Government plant was commenced in September and completed in December; by which about 406 tons of ledge rock were removed from about 5,000 square feet of ledge near the head of the river at Pawtucket, increasing the depth to at least 3.3 feet at low water over the entire ledge and about 4 feet depth over all except a small area of about 25 square feet. A minor survey was made and a new project submitted and approved for further rock excavation in accordance with the original approved project. Bids were solicited for the rock work, to be opened in July, 1894.

The contract work was under the local charge of Mr. Edward Parrish as assistant engineer, with Mr. C. O. Abel as inspector; the survey under Mr. J. H. Rostock as assistant engineer; and the rock work under Mr. Theo. McMahan as overseer.

Work required to complete the existing project.—The work yet to be done is to straighten the channel in its lower half and to deepen the channel through the ledge to the full depth and width of 40 feet.

Operations contemplated for the fiscal year ending June 30, 1895.—It is proposed to apply the balance of funds on hand and the further requested appropriations toward both the removal of the ledge and the straightening of the channel in its lower portions.

Pawtucket is in the collection district of Providence, and that port is the nearest port of entry. The amount of revenue collected at Providence in the last calendar year was $297,534.81. The nearest light-house is Sassafras Point Light. The nearest fortifications are Fort Adams, Newport, R. I., and the fort on Dutch Island, Rhode Island.

Money statement.

July 1, 1893, balance unexpended	$34, 448. 23
June 30, 1894, amount expended during fiscal year	23, 424. 74
July 1, 1894, balance unexpended	11, 023. 49
July 1, 1894, outstanding liabilities	149. 28
July 1, 1894, balance available	10, 874. 21
Amount (estimated) required for completion of existing project	202, 500. 00
Amount that can be profitably expended in fiscal year ending June 30, 1896	100, 000. 00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

COMMERCIAL STATISTICS.

The commerce arriving and leaving Pawtucket River, Rhode Island, by water during the calendar year ending December 31, 1893, is estimated as follows, based mainly upon reports received from Mr. George E. Newell, Pawtucket, R. I:

Class of goods.	Exports.	Imports.	Total.	Tonnage.
				Tons.
Cotton and products	$17, 500	$125, 000	$142, 500	700
Fertilizers	35, 000	19, 000	54, 000	1, 433
Lumber and products		262, 000	262, 000	14, 500
Coal, minerals, and products	400	850, 000	850, 400	168, 000
Sundries	7, 500	7, 500	15, 000	2, 000
Total	60, 400	1, 263, 500	1, 323, 900	186, 633

Gain over last year, none; transportation lines established during the year, none reported.

The passage of vessels through this waterway is estimated as follows (each entrance and departure together being counted as one passage):

Character or class of service.	Number.	Average draft.	Average tonnage.
Steam:		*Feet.*	*Tons.*
Freight, mainly	500	10	
Passenger, mainly	300		
Tugs	500		
Pleasure boats	800		
Barges, freight	480		
Sail:			
Freight	75	11	
Pleasure boats, small	800		

C 10.

IMPROVEMENT OF PROVIDENCE RIVER AND NARRAGANSETT BAY, RHODE ISLAND.

Providence River is an estuary of Narragansett Bay. The object of its improvement is to furnish a wide and deep channel for European and coastwise commerce from the ocean to Providence, a city which had in 1885 about 125,000 inhabitants, largely engaged in manufactures, and which is also a port of entry for an extensive region of country, to which it is connected by railroads. The mean rise and fall of the tide is 4.7 feet.

Original condition.—Before the improvement of the river was commenced, in 1853, many shoals obstructed navigation; and at one point in the channel, a place called The Crook, the available low-water depth was but 4½ feet.

Between 1852 and 1873, $56,500 was appropriated to secure depths of first 9 and then 12 feet at low water. This work was finished in 1873.

At the adoption of the present project the channel was limited to 12 feet depth, and the anchorage areas were much too small and shallow for the craft seeking them.

Plan of improvement.—The present approved project, that of 1878, as modified in 1882, provides for the deepening of the river and the deepening and widening of its anchorage basins, so as to secure a channel of at least 25 feet depth at low water with 300 feet width from the deep water of Narragansett Bay up to Providence, R. I., and so as to secure anchorage basins of 20 feet depth with 600 feet width, 18 feet depth with 725 feet width, 12 feet depth with 940 feet width, and 6 feet depth with 1,060 feet width from Fox to Field Point; all at a total cost estimated in 1882 at $675,000.

A plan of the works may be found at p. 622, Annual Report of the Chief of Engineers for 1884, and p. 830 of 1893; and farther special information at p. 235 of 1878 and p. 557 of 1882.

The 25-foot channel has been laid out in straight reaches (with enlargements at the angles), with a view to their being lighted later by range or leading lights, such as are used in similar cases in Chesapeake Bay, Delaware River, and other localities, if it should be found necessary.

Appropriations.—Upon the present project appropriations have been made as follows: 1878, $50,000; 1879, $60,000; 1880, $60,000; 1881, $60,000; 1882, $125,000; 1884, $85,000; 1886, $30,000; 1888, $40,000; 1890, $50,000; 1892, $50,000. Total up to June 30, 1893, $610,000.

Amount expended and results to June 30, 1893.—The total amount expended on the present project (including $6,433.64 outstanding liabilities) up to June 30, 1893, was $570,531.92, by which all the 25-feet-depth channels, most of the 20-feet-depth anchorages, and a part of the 18-feet-depth anchorages had been dredged, this being about five-sixths of all the proposed work.

Operations during the past fiscal year.—Value of United States plant, $24,210. Including $1,102.49 outstanding liabilities on June 30, 1894, the expenses of the year were $38,027.53.

Upon application of the contractor, approved by Department indorsement of March 8, the time of completing contract was extended to June 15, 1894; all extra expense due to this extension to be paid by the contractor. Dredging in progress at commencement of year was continued by the contractor (temporarly suspended on December 25 and resumed on April 6), and finally finished on May 14; by which 276,474 cubic yards of mud were removed from 31,126 feet length and 20 to 60 feet width of cutting; completing all the 6 to 20 feet depth anchorage areas of the Fields Point and Sassafras Point reaches, excepting a small amount of supposed ledge rock uncovered n dredging on the east side of the Fields Point Reach. Work by the

Government force and plant was commenced on June 15 and completed on June 25, by which 900 square yards area of rock bowlders and clay were blasted (using 202 pounds dynamite) and scattered, so as to leave the anchorage basins everywhere of full depths and widths. A channel survey was made from the mouth of Pawtucket (Seekonk) River at Fox Point down to and including the Pawtuxet Reach at Sabine Point.

Farther dredging awaits farther appropriations.

The contract work was under the local charge of Mr. Edward Parrish as assistant engineer, with Mr. J. F. Parks as inspector; the surveys were under Mr. J. H. Rostock as assistant engineer, and the rock removal under overseer Theo. McMahan.

Work required to complete the existing project.—There is required for the completion of the existing project the removal of a few shoaled portions of the 25-feet-depth channel.

Operations contemplated for the fiscal year ending June 30, 1895.—It is proposed to complete the project.

Providence River is in the collection district of Providence, which is a port of entry. The amount of revenue collected at Providence in the last calendar year was $297,534.81. The nearest light-houses are the 6 light-houses in Providence River. The nearest fortifications are fort on Dutch Island and Fort Adams, R. I.

Money statement.

July 1, 1893, balance unexpended	$45, 901. 72
June 30, 1894, amount expended during fiscal year	43, 358. 68
July 1, 1894, balance unexpended	2, 543. 04
July 1, 1894, outstanding liabilities	1, 102. 49
July 1, 1894, balance available	1, 440. 55
Amount (estimated) required for completion of existing project	65, 000. 00
Amount that can be profitably expended in fiscal year ending June 30, 1896	65, 000. 00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

COMMERCIAL STATISTICS.

The commerce arriving and leaving Providence River, Rhode Island, by water during the calendar year ending December 31, 1893, is estimated as follows, based mainly upon reports received from Mr. F. P. Little, secretary of the Board of Trade, Providence, R. I.:

Class of goods.	Exports.	Imports.	Total.	Tonnage.
				Tons.
Cotton and products	$17, 500	$125, 000	$142, 500	700
Fertilizers	35, 000	19, 000	54, 000	1, 400
Lumber and products		484, 500	484, 500	46, 000
Coal, minerals, and products		3, 000, 000	3, 000, 000	600, 000
General merchandise	12, 000, 000	14, 000, 000	26, 000, 000	521, 000
Sundries	7, 500	7, 500	15, 000	2, 000
Total	12, 060, 000	17, 636, 000	29, 696, 000	1, 171, 100

Gain over last year, none; transportation lines established during the year, none reported.

The passage of vessels through this waterway is estimated as follows (each entrance and departure together being counted as one passage):

Character or class of service.	Number.	Average draft.	Average tonnage.
Steam:		*Feet.*	*Tons.*
Freight and passenger	1,000	18	450
Freight mainly	1,400	20	600
Passenger mainly	1,000	7	300
Fishing	600	3	10
Tugs	6,000	7	150
Pleasure boats	1,500	5	50
Barges: Freight	800	15	1,000
Sail:			
Freight	3,000	15	400
Pleasure boats, large	300	7	40
Pleasure boats, small	2,000	3	7

C II.

REMOVAL OF GREEN JACKET SHOAL, PROVIDENCE RIVER, RHODE ISLAND.

Green Jacket Shoal is that part of Providence River which lies off the wharves on the south front of the city, being an important part of the harbor for anchorage purposes.

Original condition.—That part of the harbor in which the shoal is located is about 2,000 feet long by from 600 to 1,200 feet wide; and of this area the shoal occupied about 30 acres, that part of it which was included between the 15-foot curves measuring about 18 acres. There were channels on either side of the shoal between it and the harbor lines, having at mean low water a width of 300 feet and a depth of 20 feet on the north side, and a width varying from 50 to 100 feet and a depth of about 15 feet on the south side. The water on the summit of the shoal was only 1 foot deep.

Plan of improvement.—The present approved project, that of 1885, provides for the removal to 25 feet depth at low water of a middle-ground shoal of about 30 acres area in Providence River opposite the city, the portion to be removed to be at least 200 feet distant from the harbor lines of the city; all at a total cost estimated in 1885 at $112,346.

A plan of the works may be found at p. 598, Annual Report of the Chief of Engineers for 1885, and pp. 830 and 832 of 1893.

Appropriations.—Upon the present project appropriations have been made as follows: 1886, $26,250; 1888, $28,000; 1890, $25,000; 1892, $10,000. Total up to June 30, 1893, $89,250.

Amount expended and results to June 30, 1893.—The total amount expended on the present project (including $20.40 outstanding liabilities) up to June 30, 1893, was $79,594.77, by which 18 acres (out of the original 30) had been removed to a depth of 25 feet at mean low water, along the northern and western sides of the shoal, making an important addition to the anchorage facilities of the harbor.

Operations during the past fiscal year.—Value of United States plant, $7,820. Including $18.66 of outstanding liabilities on June 30, 1894, the expenses of the year were $9,190.91.

Dredging was commenced by the contractor in November and completed in January; by which 65,272 cubic yards of material were removed from 2,652 feet length and from 50 feet width of cutting, and to 25 feet depth at low water across the north and northwest side of the shoal, thus completing all contract work and leaving a full 16 feet depth all over the central portions of the shoal, and about 20 feet depth in the main channel way.

Further dredging awaits further appropriations.

The contract work was under the local charge of Mr. Edward Parrish as assistant engineer, with Mr. J. F. Parks as inspector; and the surveys under Mr. J. H. Rostock as assistant engineer.

Work required to complete the existing project.—The work required to complete the existing project is the further deepening of the entire area to its full depth of 25 feet.

Operations contemplated for the fiscal year ending June 30, 1895.—It is proposed to complete the project.

Green Jacket Shoal is in the collection district of Providence, which is a port of entry. The amount of revenue collected at Providence during the last calendar year was $297,534.81. The nearest light-houses are the six light-houses in Providence River. The nearest fortifications are Fort Adams, R. I., and the fort on Dutch Island, Rhode Island.

Money statement.

July 1, 1893, balance unexpended	$9,675.63
June 30, 1894, amount expended during fiscal year	9,192.65
July 1, 1894, balance unexpended	482.98
July 1, 1894, outstanding liabilities	18.66
July 1, 1894, balance available	464.32
Amount (estimated) required for completion of existing project	23,096.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	23,096.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

C 12.

IMPROVEMENT OF NEWPORT HARBOR, RHODE ISLAND.

This harbor is at the main entrance to Narragansett Bay. This bay during the summer and winter constitutes a harbor of refuge for our European and coastwise commerce quite equal in every respect to that of New York Bay, and even more accessible. The objects of the improvement are to widen and deepen the southern (the main) entrance to the harbor, and to enlarge its capacity for vessels seeking refuge in storms by increasing the area and depth of the anchorage within it. The mean rise and fall of the tide is about 3¾ feet.

Original condition.—Before improvement the capacity of the inner harbor was limited by shoals, and it was not sufficient for the vessels seeking it for refuge. The southern (the main) entrance was obstructed by a bar which stretched out from Goat Island; and the general business wharves of the city could not be reached at low tide by vessels drawing more than 8 feet.

Between 1873 and 1875, $28,500 was appropriated to dredge a 12-foot channel up to the city wharves and build a small jetty to arrest the flow of sand into the main channel and harbor, and to protect the western face of Goat Island. (See p. 29 of Annual Report of 1873.) This work was completed in 1876.

At the adoption of the present project this harbor was limited to 12 feet depth at low water, and its anchorage area too small for the craft seeking harborage at this place during the summer and all the year during storms.

Plan of improvement.—The present approved project, that of 1880, as modified in 1882, 1883, 1884, and 1890, provides for the widening and deepening of the channel from Narragansett Bay into Newport, so as to secure 15 feet depth at low water, with at least 750 feet width; for the extension of the 13-foot-depth and 10-foot-depth anchorage basins; for the partial cutting off of the shoal spit at the southern end of Goat Island, and for the construction of jetties on the western shore of Goat Island, so as to protect the end of this island from erosion, and to prevent the drift of sand, etc., around the island into the adjacent parts of the channel and harbor; all at a total cost estimated in 1890 at $156,200.

A plan of the work may be found at p. 604, Annual Report of the Chief of Engineers for 1885, and p. 838 of 1893; and further details at p. 562 of 1881, p. 561 of 1882, p. 494 of 1883, p. 624 of 1884, p. 736 of 1891, and p. 627 of 1892.

Appropriations.—Upon the present project appropriations have been made as follows: 1881, $25,000; 1882, $20,000; 1884, $20,000; 1886, $15,000; 1888, $12,000; 1890, $12,500; 1892, $25,000; total up to June 30, 1893, $129,500.

Amount expended and results to June 30, 1893.—The total amount expended on the present project (including $31.68 outstanding liabilities) up to June 30, 1893, was $105,174.71, by which the 15-foot-depth channels and 13-foot-depth anchorage basins had been dredged, and one jetty, 133 feet long, had been built westward from Goat Island.

Operations during the past fiscal year.—Value of United States plant, $2,750. Including $32.28 outstanding liabilities on June 30, 1894, the expenses of the year were $22,416.64.

By Department indorsement of November 21, the time of completing contract was extended to March 1, 1894; all extra expense due to this extension to be paid by the contractor. Dredging, in progress at commencement of year, was continued by the contractor and completed in February; by which 147,325 cubic yards of material were removed from 18,645 feet length and from 10 to 30 feet width of cutting and to 15 feet depth at low water across the southern end of the shoal spit at the southern end of Goat Island, thus completing all contract work. By Department telegram of February 10, 1894, authority was received for the hire in open market of about 4,000 cubic yards ($500) of additional dredging under existing approved projects; and under this authority and during February 3,415 more cubic yards of mud and sand, and 1,134 cubic yards of bowlders were removed from Goat Island Spit, thus completing all needed work on this spit. The old pile dolphin marking the former end of the Goat Island Spit was removed and a new pile dolphin built in February to mark the new end of this island. An electric light is now maintained on this dolphin by means of the electric plant of the U. S. Naval torpedo station.

By indorsement of March 19, from the office of the Chief of Engineers, authority was received to dredge (by hire in open market) about 1,600 cubic yards of material from the main channel, dredged in 1884 and 1886, where several small shoal spots have been recently found, and an agreement was made with the former contractor to do this work at 25 cents per cubic yard. As soon as this small amount of dredging shall be done further dredging will await further appropriations.

This work was under the local charge of Mr. Edward Parrish, as assistant engineer, with Mr. B. H. Hooper as inspector.

Work required to complete the existing project.—The work required to complete the existing project is the excavation of the 10-foot anchorage area within the harbor and the building of additional jetties outside of

Goat Island, whenever they may be required to arrest the drift of littoral sand and gravel into the harbor entrance.

Operations contemplated for the fiscal year ending June 30, 1895.—It is proposed to complete the existing project.

Newport is in the collection district of Newport, and is a port of entry. The amount of revenue collected at Newport in the last calendar year was $1,760.53. The nearest light-houses are Lime Rock and Newport (Goat Island) lights. The nearest fortification is Fort Adams, Newport, R. I.

Money statement.

July 1, 1893, balance unexpended		$24,356.97
June 30, 1894, amount expended during fiscal year		22,416.04
July 1, 1894, balance unexpended		1,940.93
July 1 1894, outstanding liabilities	$32.28	
July 1, 1894, amount covered by uncompleted contracts	400.00	
		432.28
July 1, 1894, balance available		1,508.65
Amount (estimated) required for completion of existing project		26,700.00
Amount that can be profitably expended in fiscal year ending June 30, 1896		26,700.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

COMMERCIAL STATISTICS.

The commerce arriving and leaving Newport Harbor, Rhode Island, by water during the calendar year ending December 31, 1893, is estimated as follows, based mainly upon reports received from many and various parties, and from Mr. Martin H. Ball, deputy collector of customs, Newport, R. I.

Class of Goods.	Exports.	Imports.	Total.	Tonnage.
				Tons.
Fish, oysters, etc	$15,000	$12,000	$27,000	500
Live stock and products		8,000	8,000	70
Vegetables and truck		40,000	40,000	400
Grain and forage		35,000	35,000	2,000
Tobacco		25,000	25,000	25
Cotton and products		30,000	30,000	150
Fertilizers		56,000	56,000	1,400
Lumber and products		140,000	140,000	10,500
Coal, minerals, and products		448,000	448,000	95,500
Machinery and hardware		17,000	17,000	425
General merchandise	500,000	1,000,000	1,500,000	15,000
Sundries	100,000	200,000	300,000	3,000
Total	615,000	2,011,000	2,626,000	128,970

Gain over last year, nothing special. Transportation lines established during the year, none reported.

The passage of vessels through this waterway is estimated as follows (each entrance and departure together being counted as one passage):

Character or class of service.	Number.	Average draft.	Average tonnage.
Steam:		*Feet.*	*Tons.*
Freight and passenger	900	12	1,500
Freight mainly	300	10	1,000
Passenger mainly	3,000	8	300
Tugs	800	7	80
Pleasure boats	1,000	5	50
Barges, freight	200	12	250
Sail:			
Freight	1,000	10	150
Fishing boats	500	6	15
Pleasure boats, large	1,000	4	5
Pleasure boats, small	2,500	2	3

C 13.

HARBOR OF REFUGE AT POINT JUDITH, RHODE ISLAND.

Point Judith is the southeastern extremity of South Kingston, R. I., and marks the southwestern entrance to Narragansett Bay.

Original condition.—Its shores are covered with bowlders, and a number of wrecks are scattered along the beach on each side of the point. A long ledge, known as Squid Ledge, extends for nearly a mile in a south by easterly direction about 1½ miles west of the point.

At the adoption of the present project this point was a specially dangerous place for boats and tows to pass during storms and even ordinarily bad weather.

Plan of improvement.—The present approved project, that of 1889, provides for the construction of a national harbor of refuge nearly a mile square at this point by means of stone breakwaters, planned so as to give protection against easterly, southerly, and westerly storms, the mainland itself forming a protection on the north; all at a total cost estimated in 1889 at $1,250,000.

By the act of July 13, 1892, authority was given to the Secretary of War to make contracts for the completion of the project on the basis of the above-estimated total cost, the work to be paid for as appropriations may from time to time be made by law.

A description of the works may be found at page 595, Annual Report of the Chief of Engineers for 1890, and a general plan of the same in House Ex. Doc. No. 66, of the Fifty-first Congress, first session, and p. 840 of 1893.

Appropriations.—Upon the present projects appropriations have been made as follows: 1890, $75,000; 1892, $75,000; 1893, $100,000; total up to June 30, 1893, $250,000.

Amount expended and results to June 30, 1893.—The total amount expended on the present project (including $616.46 outstanding liabilities) up to June 30, 1893, was $75,964.06, by which a quarry was opened and quarry and floating plant built; the breakwater had been commenced at its center, about 200 feet length raised to about low level, and a beacon light established thereon.

Operations during the past fiscal year.—Value of United States plant, $13,330. Including $35,482.28 outstanding liabilities on June 30, 1894, the expenses of the year were $122,788.40.

Stone work was commenced by the contractor in August and continued up to the end of the year, by which 92,939 tons of stone was placed on the west and south wings of the breakwater, by which it was extended to a total length of about 3,000 feet on the bottom and about 1,000 feet at low-water level.

This work was under the local charge of Mr. Edward Parrish as assistant engineer, with Mr. John A. Dill as inspector.

Work required to complete the existing project.—The work required to complete the existing project is the extension of the breakwater.

Operations contemplated for the fiscal year ending June 30, 1895.—It is proposed to apply the balance on hand and the next appropriation to continuing the construction of the breakwaters.

Point Judith is in the collection district of Newport, which is a port of entry. The amount of revenue collected at Newport in the last calendar year was $1,760.53. The nearest light-house is Point Judith Light. The nearest fortification is the fort on Dutch Island, Rhode Island.

Money statement.

July 1, 1893, balance unexpended		$174,652.40
June 30, 1894, amount expended during fiscal year		87,922.58
July 1, 1894, balance unexpended		86,729.82
July 1, 1894, outstanding liabilities	$35,482.28	
July 1, 1894, amount covered by uncompleted contracts	45,154.51	
		80,636.79
July 1, 1894, balance available		6,093.03
Amount (estimated) required for completion of existing project		1,000,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896		800,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

COMMERCIAL STATISTICS.

The number of vessels passing Point Judith, R. I., during the calendar year ending December 31, 1893, is estimated as follows, based mainly on reports received from Mr. Asa Church, keeper Point Judith Life-Saving Station, Rhode Island:

Character or class of service.	Number.	Average approximate tonnage.	Total tonnage.
		Grs. tons.	*Grs. tons.*
Steamers (freight, fish, and passenger)	12,000	500	6,000,000
Yachts (steam and sail)	7,000	100	700,000
Schooners (2, 3, and 4 masts)	34,000	600	20,400,000
Ships (barks and barkentines)	200	900	180,000
Brigs and brigantines	200	300	60,000
Sloops	2,000	20	40,000
Barges	9,600	300	2,880,000
Total	65,000	....	30,260,000

C 14.

HARBOR OF REFUGE AT BLOCK ISLAND, RHODE ISLAND.

This island is part of the State of Rhode Island; is 14 miles east of Montauk Point, the eastern end of Long Island, and is about 10 miles from the nearest point of the mainland. Besides supplying the wants of the mackerel-fishing fleet and the general coast navigation the island is an important point on our shores for ocean navigation. It has a signal station connected by submarine telegraph with the mainland. Vessels are passing the island at all times and on all sides of it, and its position renders it of national importance. The object of the improvement is to furnish a harbor of refuge for medium-draft vessels engaged in foreign and coastwise commerce. The mean rise and fall of the tide is about 3 feet.

Original condition.—Before the construction of the present harbor of refuge Block Island had no harbor which afforded protection for decked vessels. The only ones used were open boats, which, on the approach of storms, were hauled up on the beach by oxen. The largest of these boats were of about 10 tons burden.

Between 1870 and 1876 $285,000 was appropriated to build a breakwater for a harbor of medium-draft vessels. This work, including an inner harbor of 7 feet depth for temporary use of the Government plant, was completed in 1878. (See p. 202 of Annual Report of 1877 and p. 313 of 1879.)

In 1880 $6,000 was appropriated for dredging the inner basin to 9 feet depth. This work was completed in 1881. (See p. 390 of Annual Report of 1880 and p. 563 of 1881.)

In 1882 $19,000 was appropriated for building a sea wall on the east side of the inner basin and protecting the cliffs on east side of breakwater. (See p. 563 of Annual Report of 1882.) This work was completed in 1884.

In 1884 $15,000 was appropriated for additions to the old breakwater. (See p. 628 of Annual Report of 1884.) This money was spent in 1884–'85 in partially closing a gap in this old breakwater.

At the adoption of the present project this harbor was neither large enough nor well enough protected for the proper harborage of the craft seeking refuge at this place during storms and bad weather.

Plan of improvement.—The present approved project, that of 1884, as modified in 1888, provides for the construction of a harbor of refuge on the eastern side of the island, consisting of an enlarged inner harbor (or basin) for small vessels and an exterior harbor for large ones. The basin was to be about 800 feet square and completely inclosed except at its 100-feet wide entrance. The exterior harbor was already formed by an old breakwater on the east and the adjacent shore on the south and west, but an old gap near the end of this breakwater was to be filled up. The project covers the construction of the stone sea walls of the enlarged inner harbor ($46,000), the repair of the old breakwater ($24,000), and a little dredging ($5,000) along the western side of the old breakwater and also inside the harbor; all at a total cost estimated in 1888 at $75,000.

A plan of the works may be found at p. 612, Annual Report of the Chief of Engineers for 1885, and p. 844 of 1893; and further details at pp. 609 and 613 of 1885 and p. 506 of 1888.

Appropriations.—Upon the present project appropriations have been made as follows: 1886, $20,000; 1888, $15,000; 1890, $15,000; 1892, $24,000. Total up to June 30, 1893, $74,000.

Amount expended and results to June 30, 1893.—The total amount expended on the present project (including $2,959.72 outstanding liabilities) up to June 30, 1893, was $54,581.50, by which the gap in the old breakwater had been filled up so as to make the breakwater of 1,900 feet total length; the north sea wall had been built to 170 feet length with full height; then came a gap of 190 feet length; then 130 feet length to full height, then 100 feet length to high-water level, then 150 feet length to low-water level, and the west sea wall had been started 50 feet at its shore end.

Operations during the past fiscal year.—Value of the United States plant, $2,400. Including $422.82 outstanding liabilities on June 30, 1894, the expenses of the year were $17,355.76.

Stonework, in progress at the commencement of the year, was continued by the contractor, and 5,312 tons of stone (making 6,309 tons under the present contract) were put in position in the harbor walls, and 38 piles for the wooden fender piers were driven in place and capped. By letters of the Chief of Engineers of September 22, November 17, and December 9, 1894, the time of completion was extended to January 10, 1894. All contract work was finished on December 10, the contractor not finding it necessary to make use of the last extension of time granted him. In October authority was asked and received for the purchase in open market of from 400 to 500 extra tons of stone (about $1,000 worth) in order to complete the sea walls in the manner provided for by the existing approved projects, and an agreement was made with the present contractor for the delivery of this extra stone at contract rates. Under this agreement 442 tons of stone were put in position in the harbor walls during October and November, thus completing all stonework. During July and August, 1893, the Government plant removed a dangerous bowlder from inside the harbor and 4,452 cubic yards of hard sand to a depth of 12 feet at low water from the shoaled entrance to the enlarged inner harbor and 960 cubic yards soft mud to a depth of 10 feet at low water from the shoaled entrance to the smaller inner harbor. During May and June, 1894, the Government plant also removed about 1,013.5 tons of bowlders from the old stone jetty in the western part of the harbor and from the harbor itself, of which 973.5 tons were placed in front of the north and west walls, to repair gaps made by recent storms, and on top of the crib work, and 208 tons outside the east wall of the inner harbor, all of this in such way as to strengthen all walls where most needed. Further stonework and the general dredging of the harbor awaits further appropriations.

Lights have been maintained on the north sea wall during the year.

The contract work was in the local charge of Mr. Edward Parrish as assistant engineer, with Mr. K. P. Partelow as inspector; the dredging under Mr. J. H. Rostock as assistant engineer, and the rock removal under overseer Theo. McMahan.

Work required to complete the existing project.—The work required to complete the existing project is the construction of pier heads, the strengthening of the weaker parts of the existing walls, and a little occasional dredging.

Operations contemplated for the fiscal year ending June 30, 1895.—It is proposed to complete the existing project.

Block Island is in the Newport collection district, and Newport is the nearest port of entry. The revenue collected in Newport in the last calendar year was $1,760.53. There is no duty collected at the island. The value of the harbor is mainly as a harbor of refuge. There are several lights at the island. The nearest fortification is Fort Adams, R. I.

Money statement.

July 1, 1893, balance unexpended	$22,378.22
June 30, 1894, amount expended during fiscal year	19,892.66
July 1, 1894, balance unexpended	2,485.56
July 1, 1894, outstanding liabilities	422.82
July 1, 1894, balance available	2,062.74
Amount (estimated) required for completion of existing project	1,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	1,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

COMMERCIAL STATISTICS.

The commerce arriving and leaving Block Island, R. I., by water during the calendar year ending December 31, 1893, is estimated as follows, based mainly upon reports received from Mr. C. C. Ball, Block Island, R. I.:

Class of goods.	Exports.	Imports.	Total.	Tonnage.
				Tons.
Fish, oysters, etc	$97,000	$2,500	$99,500	2,500
Live stock and products	96,000	101,000	197,000	2,000
Vegetables and truck	5,800	1,000	6,800	350
Grain and forage	550	22,125	22,675	800
Rice		1,800	1,800	20
Tobacco		20,000	20,000	30
Cotton and products		3,125	3,125	5
Fertilizers		4,200	4,200	120
Lumber and products		112,500	112,500	5,000
Coal, minerals, and products		67,750	67,750	7,400
Machinery and hardware		1,000	1,000	10
General merchandise		381,000	381,000	6,000
Sundries	61,750	65,250	127,000	13,000
Total	261,100	783,250	1,044,350	37,235

Gain over last year, about 4,500 tons, or $200,000. Transportation lines established during the year, none reported.

The passage of vessels through this waterway is estimated as follows (each entrance and departure together being counted as one passage):

Character or class of service.	Number.	Average draft.	Average tonnage.
		Feet.	*Tons.*
Steam:			
Freight and passenger	700	7	500
Fishing	400	7.5	130
Tugs	100	7.5	130
Pleasure boats	600	7	140
Sail:			
Freight	250	9	150
Fishing boats	5,500	8	30
Oyster boats	300	7	10
Pleasure boats, large	800	7	15
Pleasure boats, small	60,000	5.5	5

C 15.

IMPROVEMENT OF PAWCATUCK RIVER, RHODE ISLAND AND CONNECTICUT.

The navigable part of Pawcatuck River extends from the manufacturing town of Westerly to Little Narragansett Bay, into which it empties. The approach to the river is through Stonington Outer Harbor and Little Narragansett Bay, and the object of the improvement is to deepen and widen the river channel leading from this bay to Westerly.

The mean rise and fall of the tide is 2.6 feet at the mouth of the river and 2.3 feet at Westerly.

Original condition.—Before improvement the channel was narrow, crooked, and obstructed by numerous shoals, on some of which there was but 1½ feet at mean low water. (For map see p. 314 of Annual Report of 1879.)

Between 1871 and 1876, $50,000 was appropriated for the excavation of a channel 5½ feet deep at mean low water, 75 feet wide below the wharves, and from 35 to 40 feet wide between the lower and upper wharves. This work was completed in 1876. (See p. 211 of Annual Report of 1876.)

At the adoption of the present project the channel was limited to 5.5 feet depth over 75 feet width below the city and the same depth over 35 feet width opposite the city; and rock ledges crossed the channel at several points.

Plan of improvement.—The present approved project, that of 1885, provides for the deepening and widening of the river so as to secure a channel of at least 8 feet depth at low water with 100 feet width from its mouth up to the lower wharves of Westerly, and thence a channel of the same depth with about 40 feet width up to the upper wharves of the city; all at a total cost estimated in 1891 at $42,400.

A plan of the works may be found at p. 624, Annual Report of the Chief of Engineers for 1885, and p. 848 of 1893; and further special information at p. 634 of 1892.

Appropriations.—Upon the present project appropriations have been made as follows: 1886, $12,000; 1888, $10,000; 1890, $16,600; 1892, $3,800. Total up to June 30, 1893, $42,400.

Amount expended and results to June 30, 1893.—The total amount expended on the present project (including $78.87 outstanding liabilities) up to June 30, 1893, was $39,332.12, by which the 8 feet depth channel had been completed from deep water upward for full width to within a half mile of the city, and for partial width for the remaining distance.

Operations during the last fiscal year.—Value of the United States plant, $2,250. Including $61.37 outstanding liabilities on June 30, 1894, the expenses of the last fiscal year were $1,963.17.

The work of blasting and removing bowlders and ledge rock by the Government plant was commenced in August and completed in September; by which about 67 tons of bowlders and 59 tons of ledge rock were removed from about 3,000 feet length of the 40-foot channel between the wharves at Westerly, and from about 1,000 feet length of the 100-feet channel below the city, leaving nothing of these obstructions above the general bottom of the existing channel. A minor survey was made to show the results of past field work and also to serve as a basis for future improvement. Further dredging will probably have to await further appropriations.

This work was under the local charge of Mr. J. H. Rostock as assistant engineer, and the rock removal under Mr. Theo. McMahan as overseer.

Work required to complete the existing project.—The work required to complete the existing project is the dredging of the channel to a depth of 8 feet at mean low water and full width of 100 feet over the half mile below Westerly, and a width of 40 feet between the upper and lower wharves of that town.

Operations contemplated for the fiscal year ending June 30, 1895.—It is proposed to complete the work.

Pawcatuck River is in the collection districts of Providence and Stonington, the dividing line passing through the river. Providence and Stonington are the nearest ports of entry. The revenue collected in the last calendar year was: Providence, $297,534.81; Stonington, $890.99. The nearest light-houses are the Stonington and Watch Hill lights. The nearest fortification is Fort Trumbull, New London, Conn.

Money statement.

July 1, 1893, balance unexpended	$3,146.75
June 30, 1894, amount expended during fiscal year	1,980.67
July 1, 1894, balance unexpended	1,166.08
July 1, 1894, outstanding liabilities	61.37
July 1, 1894, balance available	1,104.71

COMMERCIAL STATISTICS.

The commerce arriving and leaving Pawcatuck River, Rhode Island, by water during the calendar year ending December 31, 1893, is estimated as follows, based mainly upon reports received from Messrs. Maxson & Co., Westerly, R. I.:

Class of goods.	Exports.	Imports.	Total.	Tonnage.
				Tons.
Fish, oysters, etc	$3,000		$3,000	75
Vegetables and truck		$2,000	2,000	125
Grain and forage		10,000	10,000	600
Fertilizers		7,500	7,500	200
Lumber and products		106,000	106,000	5,500
Coal, minerals, and products		148,000	148,000	29,000
Sundries		9,500	9,500	468
Total	3,000	283,000	286,000	35,968

Gain over last year, none. Transportation lines established during the year, none reported.

The passage of vessels through this waterway is estimated as follows (each entrance and departure together being counted as one passage):

Character or class of service.	Number.	Average draft.	Average tonnage.
		Feet.	*Tons.*
Steam:			
Freight	5		
Passenger, mainly	720	5	50
Tugs	600	6	50
Pleasure boats	75		
Sail:			
Freight	170	10	
Fishing boats	75		
Pleasure boats, large	100		
Pleasure boats, small	300		

C 16.

HARBOR OF REFUGE AT STONINGTON, CONNECTICUT.

Stonington Harbor lies on the north side of the eastern entrance from the ocean into Long Island Sound. The main object of the improvement is to furnish a harbor of refuge for vessels entering and leaving this entrance to the sound. The mean rise and fall of the tide is about 2¾ feet.

Original condition.—Originally it was an open bay, unprotected from southerly storms, and obstructed by a shoal having a low-water depth of but 6 feet at the shoalest part. This shoal nearly filled the inner harbor, and left but a narrow channel on either side, of a depth insufficient to permit vessels of 12 feet draft to reach the upper wharves at low water.

Between 1827 and 1831 about $37,000 was spent in constructing piers or small breakwaters in the inner harbor for the protection of the harborage. (See p. 326, part 1, Annual Report of 1879.)

Between 1871 and 1873 $46,166 was appropriated for a survey of the harbor and for dredging the harbor to 12 feet depth. This work was finished in 1875. (See p. 246, part 2, Annual Report of 1874.)

Between 1875 and 1879 $112,500 was appropriated for the construction of a western breakwater, running southeast 2,000 feet from Wampasset Point to 18 feet depth of water, and for dredging to 12 feet depth inside of this breakwater. (See pp. 243, 244, 245, part 2, Annual Report of 1875.) This work was completed in 1880.

At the adoption of the present project the harbor had no eastern breakwater.

Plan of improvement.—The present approved project, that of 1880, provides for the construction of an eastern breakwater as a protection to the outer harbor; this breakwater, about a half mile long, to extend from the vicinity of Bartlett Reef to the vicinity of the Middle Ground Shoal, or until it gives sufficient protection to the harbor against southerly winds; all at a total cost, estimated in 1884, at $143,000 to $191,000, according to the length to be given to the breakwater; both estimates to be increased later by the cost of a light-house foundation on the end of the finished jetty.

A plan of the works may be found at p. 598, Annual Report of the Chief of Engineers for 1882, and p. 632 of 1884, and p. 848 of 1893; and further information at p. 585 of 1881.

The position of the ends of the eastern breakwater has not yet been definitely determined, but it will probably be found necessary, in order to afford all the protection desired, to extend the breakwater at its eastern end to Bartlett Reef, and at its western end until it intersects a range from the end of the western breakwater to the middle of Wicopessit Island, so as to thoroughly shelter the harbor from southerly storms.

Appropriations.—Upon the present project appropriations have been made as follows: 1880, $25,000; 1881, $30,000; 1882, $25,000; 1884, $10,000; 1886, $20,000; 1888, $8,000; 1890, $12,500; 1892, $12,500. Total up to June 30, 1893, $143,000.

Amount expended and results to June 30, 1893.—The total amount expended on the present project (including $79.29 outstanding liabilities) up to June 30, 1893, was $131,141.61, by which this breakwater had been built to full height and 2,377 feet length.

Operations during the past fiscal year.—Value of United States plant, $1,120. Including $249.26 outstanding liabilities on June 30, 1894, the expenses of the year were $1,436.98.

During the year, general office work. A minor survey was made to show the results of past fieldwork, and also to serve as a basis for future improvement. Bids have been invited for about $10,000 of stonework, to be opened in July, 1894.

A light has been maintained upon the end of the eastern breakwater during the year. This work was in the local charge of Mr. J. H. Rostock as assistant engineer.

Work required to complete the existing project.—The work required to complete the existing project is the extension of the eastern breakwater perhaps 600 feet at its eastern end and perhaps 1,300 feet at its western end, according to the results of surveys of the coming season.

Operations contemplated for the fiscal year ending June 30, 1895.—With the present available funds it is proposed to extend the eastern breakwater at its eastern end.

Stonington Harbor is in the Stonington collection district and is a port of entry. The amount of revenue collected at Stonington in the last calendar year was $890.99. The principal value of the harbor is as a harbor of refuge. The nearest lights are Stonington Light and Latimer Reef Light. The nearest fortification is Fort Trumbull, New London Harbor, Connecticut.

Money statement.

July 1, 1893, balance unexpended	$11,937.68
June 30, 1894, amount expended during fiscal year	1,267.01
July 1, 1894, balance unexpended	10,670.67
July 1, 1894, outstanding liabilities	249.26
July 1, 1894, balance available	10,421.41

COMMERCIAL STATISTICS.

The commerce arriving and leaving Stonington Harbor, Connecticut, by water during the calendar year ending December 31, 1893, is estimated as follows, based mainly upon reports received from Mr. C. T. Stanton, collector of customs, Stonington, Conn., and Mr. J. W. Miller, president, New York and Stonington Steamship Line, New York City:

Class of goods.	Exports.	Imports.	Total.	Tonnage.
				Tons.
Fish, oysters, etc	$9,000		$9,000	150
Grain and forage		$24,000	24,000	1,400
Fertilizers		7,500	7,500	200
Lumber and products		150,000	150,000	7,500
Coal, minerals, and products	27,000	420,000	447,000	81,500
General merchandise	24,000,000	21,000,000	45,000,000	211,000
Sundries	44,000	44,000	88,000	4,000
Total	24,080,000	21,645,500	45,725,500	305,750

Gain over last year, nothing special; transportation lines established during the year, none reported.

The passage of vessels through this waterway is estimated as follows (each entrance and departure together being counted as one passage):

Character or class of service.	Number.	Average draft.	Average tonnage.
		Feet.	*Tons.*
Steam:			
Freight and passenger	425	12	1,500
Freight mainly	38	10	1,000
Fishing	38	6	25
Tugs	200	6	30
Sail:			
Freight	1,000	10	150
Fishing boats	500	6	30
Pleasure boats, small	1,000	2.5	

C 17.

REMOVING SUNKEN VESSELS OR CRAFT OBSTRUCTING OR ENDANGERING NAVIGATION.

1. WRECK OF STEAM YACHT ALVA.

The steel steam yacht *Alva* was in the month of October, 1892, reported as being sunk in about 22 feet depth of water, in location approximately 1 mile northeast of Pollock Rip Light Vessel in the middle of Pollock Rip Channel, eastern entrance to Nantucket Sound, Massachusetts, and as being a dangerous obstruction to the deep and shallow draft steam and sailboat navigation of the neighborhood.

At the time (July 24, 1892), when originally wrecked (by collision) this vessel was on a pleasure trip and therefore without special cargo. Her measurements were approximately as follows: Length, 256 feet; breadth, 32 feet; depth, 18 feet; gross tonnage, 1,151 tons.

Shortly after sinking, this vessel was sold to a wrecking company, who worked upon her about three months (at a reported expense of from $10,000 to $20,000) in the hopes of floating her and removing her in an entirety. She was, however, abandoned by them on November 23, 1892.

As soon as it was evident that this wreck could not be saved by its owners, then under the provisions of Section IV of the river and harbor act of June 14, 1880, and by direction of the Secretary of War of October 22, 1892, and of the Chief of Engineers of the same date, the destruction and removal of this wreck by the United States was ordered; work to be done by contract after due advertisement. In accordance therewith bids were opened on December 3, 1892, and a contract or agreement was entered into with Messrs. Kelley and Van Sant, of Atlantic City, N. J., under date of December 12, approved December 29, 1892; work to be commenced January 14 and finished May 14, 1893. Specially bad weather prevented fieldwork during a portion of the winter and spring, on account of which the contractor was authorized to delay commencement until March 15 and completion until July 15, 1893; but finally under Mr. J. H. Rostock as assistant engineer, and Mr. Theodore McMahan as diver and inspector, and Mr. C. O. Abel and Mr. B. H. Hooper as occasional inspectors, work in the field was commenced March 15, 1893, and completed July 6, 1893.

The first information received about this wreck, based upon Coast Survey maps and casual reports from the working party of the first purchasers of the wreck, indicated the wreck as lying in only about 22 feet at low water with bare rails; but a subsequent careful examination made December 17, 1892, showed her to be lying directly across the current on a gentle slope whose depths varied from about 27 to 30 feet at low water, the sand bottom being banked up a few feet around her middle and scoured out to 10 feet additional depth around both bow and stern, the least depth upon her upper portions being about 10 feet.

Either from bad weather or accidents to his plant, or from other causes, the contractor succeeded in actually working at the place of the wreck only twenty days in all (one day in March, four days in April, nine days in May, four days in June, and two days in July). During this time about 8,000 pounds of dynamite were exploded in and around the wreck in charges of from 10 to 1,710 pounds each.

The work was inspected under water at several different times by the United States diver and inspector. Other examinations were also many times made from the surface by means of a sweep arranged to lie horizontally in the water at any desired depth below the surface; this sweep, covering a width of 40 feet, having been sunk to successive depths of 18, 20, 22, 24, and 26 feet, and having been moved slowly over the entire area of the wreck at nearly slack tide.

Final inspection, made on July 6 by both diver and sweep, showed the bow, stern, and sides of the vessel to be all broken up into small pieces and scattered around in such way as to not rise anywhere more than 2 or 3 feet above the bottom; the interior of the vessel, including what was left of its boilers, engines, other machinery, and decks, forming a pile of about 40 feet diameter and from 4 to 8 feet height at the center of the wreck, and the least water to be found over the highest projecting points of this wreckage being 26 feet at slack water (which would be 24 feet or more at lowest water).

No property was recovered from the wreck, and no attempt was made to do so, since the cost of such work would have been greater than the value of the material saved (either through the direct expense of such work, or of the delay thereby caused to the main work of destruction of the wreck itself).

The total cost of this work was $7,241.67, including the contract price, and all expenses of first examination, subsequent inspection, and other superintendence in the field and office.

The experience of this wreck is greatly against such work as this being done by advertisement and contract: (1) Because of the long delay (usually two months) necessary for the advertisement and the formalities of the contract, during which time the wreck is liable to cause other wrecks; (2) because of the still greater interval (usually three months) between the preparations of specifications and the actual dates of field work, during which time the condition of the wreck and surroundings may be so changed by storms that specifications must be to a large extent delusive, and bids to a large extent guesswork; and (3) because the lowest bidder under such circumstances is not generally the best man for the work. In this particular case, if advertisement had been omitted and the work either done by the Government by its own hired labor or awarded in open market, the wreck might have easily been destroyed and scattered before the commencement of last winter. As it was, the two months' delay for advertisement and contract deferred action in the field until after the commencement of the stormy winter season, when work was impossible, and prevented work until late in the spring, causing six months' delay, during all of which time this wreck was a great danger to thousands of boats, three of which were wrecked thereby. The value of these three wrecked boats would have much more than paid for the open-market cost of the entire and rapid destruction of the *Alva*.

Again, the experience of this wreck has shown the advantage of not attempting to save any of the cargo. Had it been required that the cargo should have been saved and carried ashore for sale, the time necessary for the removal of the obstruction would have been at least double, and the cost of the work would have been several times increased.

2. WRECK OF SCHOONER OCEAN TRAVELLER (AT MONOMOY).

An old wreck of a wooden schooner (name afterwards found to be the *Ocean Traveller*) was in May, 1893, reported as lying just outside Monomoy Point, southern end of Cape Cod, Massachusetts, and as being a dangerous obstruction to the deep and shallow draft steam and sailboat navigation of the neighborhood. By direction of the Secretary of War of May 22, 1893, and the Chief of Engineers of May 23, 1893, her destruction and removal was ordered; work to be done by hired labor, and the use of the Government plant.

According to the best available reports, this schooner, the *Ocean Traveller*, while on her way from some Southern port to some port north of Cape Cod, several years ago, run upon the southern edge of Shovelful Shoal and sank. She was a wooden centerboard one masted vessel. Her dimensions were approximately as follows: Length, 140 feet; breadth, 30 feet; depth, 9 feet; gross tonnage, 300. The date of her construction and her last ownership was unknown. When sunk she was loaded with paving stones.

Examinations of the wreck, made June 29 and July 4, showed the wreck almost intact, except as to rigging and a small portion of her port side aft, her cargo still being firmly in place; the wreck having only 3 feet of water over its bow and stern, and yet lying in 10 to 13 feet of water on the deep-water edge of the shoal at a point approximately 1,200 yards southeast of Monomoy Point tripod and 3,000 yards south southwest of Monomoy Point Light. Though out of the main channel, she still lay where she was specially liable to be struck by the numerous small and large craft beating their way against the wind on their route around Monomoy Point on their way from Chatham Roads or the west to Pollock Rip, and therefore it was thought best that she be completely destroyed down to the level of the adjacent sand bottom. The location of the wreck at that time is shown by sketches and maps now on file in the Newport office.

Field work upon this wreck was commenced on July 4 under Mr. Theodore McMahan as diver and inspector, using a hired sailboat and crew, and was completed on July 7. The under-water work was all done in two days; two other days being lost on account of bad weather. The outer hull, which was found solid and firm, was shattered by 240 pounds of dynamite in 25 charges of from 2 to 10 pounds each, by which both hull and cargo were entirely broken up and scattered over the ocean bottom.

A final inspection made on July 7 showed that everything had been removed down to a level of from 10 to 16 feet below low water, this being within less than a foot of the general level of the surrounding bottom.

No property of any value was recovered.

The total cost of this work was $195.15, including all expenses of first examination, all fieldwork, final inspection, and other superintendence.

3. WRECK OF SCHOONER NELLIE V. ROKES.

The wooden schooner *Nellie V. Rokes*, was in May, 1893, reported as lying a short distance southeast of the Chatham Life-Saving Station, Monomoy, southern end of Cape Cod, Massachusetts, and as being a dangerous obstruction to the shallow-draft sailboat navigation of the neighborhood. By direction of the Secretary of War of May 22, 1893, and the Chief of Engineers of May 23, 1893, the work of her destruction and removal was ordered; work to be done by hired labor and the use of the Government plant.

According to the best available reports, this schooner, the *Nellie V. Rokes*, while on her way from some southern port to some port north of Cape Cod, in about 1890, ran upon the beach and was abandoned. She was a wooden single-decked 3-masted schooner (oak and pine) belonging to J. B. Drake, and was built in Bath, Me., in 1879, and documented from that port. Her dimensions were approximately as follows: Length, 125 feet; breadth, 32 feet; depth, 9 feet; tonnage, 296 gross, 281 net. When sunk, she was loaded with paving stones.

Examinations of the wreck, made June 29 and July 1, showed the hull of the wreck to be almost intact, her cargo still being firmly in place, the wreck being well sanded up and having only from 1 to 2.5 feet of water over her decks, and lying in from 5 to 9 feet depth of water at a point approximately 1,100 yards southeast of the Chatham Life-Saving Station, Monomoy. Though out of the main channel, she still lay where she was liable to be run into by the many small vessels which are obliged to follow close along the shore in times of foggy weather and cloudy nights, in order to avoid the still more dangerous outer shoals of this locality; and it was, therefore, thought not well to allow any portion of the wreck to permanently project above the sand of the adjacent ocean bottom. The location of the wreck at that time is shown by sketches and maps now on file in the Newport office.

Field work upon this wreck was commenced on July 1, under Mr. Theo. McMahan as diver and inspector, using a hired sailboat and crew, and was completed, together with other work, on August 7. The under-water work was all done in four days, seven other days being spent in waiting for favorable weather, etc. The outer hull and decks of the wreck, which were found solid and firm, were shattered by 425 pounds of dynamite in 72 charges of from 2 to 20 pounds each, by which both hull and cargo were entirely broken up and scattered over the ocean bottom.

A final inspection made on August 7, 1893, showed that everything had been removed down to a level of from 5 to 9 feet below low water, this being the general level of the surrounding bottom.

No property of any value was recovered.

The total cost of this work was $446.04, including all expenses of first examination, all field work, final inspection, and other superintendence.

4. WRECK OF SCHOONER ROGERS.

The schooner *Rogers* was in June, 1893, reported as lying on Handkerchief Shoals, about a mile southwest of Monomoy Point, southern end of Cape Cod, Massachusetts, and as being a dangerous obstruction to the medium-draft sailboat navigation of the neighborhood. By direction of the Secretary of War of June 12, 1893, and the Chief of Engineers of June 13, 1893, the work of her destruction and removal was ordered; work to be done by hired labor and the use of the Government plant.

According to the best available reports this schooner, the *Rogers*, while on her way from New York to Boston, went ashore in a snowstorm on Handkerchief Shoal on April 6, 1893. She was a single-deck three-masted wooden schooner. Her dimensions were, approximately, as follows: Length, 115 feet; breadth, 31 feet; depth, 9 feet; gross tonnage, 266; net tonnage, 253.63. She was built in 1888 at Millbridge, Me., was documented from Machias, Me., and was owned by George N. Rogers. When sunk she was loaded with coal. When originally sunk she lay in the entrance to the slue of Handkerchief Shoal, but by the winds and tides she was gradually drifted nearly three-quarters of a mile westwardly during the following two months. In the same interval two of her masts and almost all of her coal were removed by the original or subsequent owners.

Examination of the wreck, made on July 7 and 8, showed the hull of the vessel to be intact, except as to the after part of the main deck, the wreck having from 2 to 18 feet of water over her decks, and lying in from 24 to 30 feet depth of water at a point approximately 2,500 yards west-southwest from the Monomoy Point tripod. As the wreck, though out of the main channel, still lay where she was liable to be struck by the numerous small craft using the slue route through and across Handkerchief Shoal on their way to and from Chatham Roads, it was thought best that she be completely destroyed down to the level of the adjacent sand bottom. The location of the wreck at that time is shown by sketches and maps now on file in the Newport office.

Field work upon this wreck was commenced on July 8 under Mr. Theo. McMahan as diver and inspector, using a hired sailboat and crew, and was completed on July 14. The under-water work was all done in five days, three other days being spent in waiting for favorable weather, etc. The outer hull and decks of the wreck, which were found almost new and firm and solid, were shattered by 566 pounds of dynamite, in 31 charges, of from 5 to 30 pounds each, by which the wreck was entirely broken up, a large part of the wreckage floating away and the rest being scattered over the ocean bottom.

A final inspection made on July 14 showed that everything had been removed down to a depth of from 25 to 30 feet below low water, this being about the general level of the surrounding bottom, and about 5 to 10 feet below the level of the bottom along the route over which approaching vessels must come.

No property of any value was recovered, and no attempt was made to do so, since the cost of such work would have been greater than the value of the material saved, either through the direct expenses of such work or the delay thereby caused to the main work of destruction of the wreck itself.

The total cost of this work was $337.56, including all expenses of first examination, all field work, final inspection, and other superintendence.

5. WRECKS IN VINEYARD HAVEN.

Three isolated wrecks, and two piles of wreckage (in all, seven old wrecks) were in July, 1893, reported as having lain for several years in Vineyard Haven, Marthas Vineyard, Mass., and as having been great nuisances and dangerous obstructions to the medium and light-draft sail and steam boat navigation of that harbor. By direction of the Secretary of War of July 17 and 31, 1893, and of the Chief of Engineers of the same date, the work of their destruction and removal was ordered; work to be done by hired labor and the use of the Government plant.

According to the best available reports, these wrecks were all those of medium-sized wooden vessels, which, at various times during the past eight to twelve years, have either struck on shoals in the harbor or have been brought in in sinking condition, run ashore, stripped of everything of value, and then abandoned. In four cases the cargo was of lime, and the vessels were undoubtedly on fire when run ashore. In the other three cases the cargo is now unknown. These wrecks had been many times struck (once as late as July, 1893, by a steamboat) by boats using the harbor, and there had been many narrow escapes from serious accidents to other medium-draft vessels, this harbor being a much-frequented one, especially during cloudy nights and bad fogs.

Examination of these wrecks made during July and August, 1893, gave results as follows:

Wreck No. 1 (said to be that of the *R. H. Shannon*) was found to have its hull (about 100 feet in length and 20 feet breadth) tolerably intact; the ship timbers, large portions of the planking, inside ceiling, and centerboard casing being still in fair condition; no cargo being left in her; the entire wreck being well sanded up inside and out; having only about 3 feet depth of water over her woodwork, and lying in from 5 to 7 feet depth of water, at a point about 1,200 yards from the head of the bay, about 300 yards from the east shore, and about 30 yards southwest of the shoal buoy opposite the entrance to Lagoon Pond (as shown on Coast Survey Chart No. 347).

Wreck No. 2 (said to be that of the *Alma*) was found to have its hull (about 140 feet in length and 30 feet in breadth) tolerably complete and firm, the stem, sternpost, keelson, and keel particularly so, with several feet depth of lime still inside of her, having only from 1 to 5 feet depth of water over her woodwork, and lying in from 11 to 14 feet depth of water at the head of the harbor at a point about 500 feet south southwest of the marine railway and about 150 feet from the shore.

Wreck No. 3 (said to be that of the *Julia* or *Juliette*) was found to have its hull (about 130 feet in length and 30 feet in width) in tolerably fair condition; to be full of lime; its ribs to rise slightly above low water; the wreck lying in from 5 to 9 feet depth of water about 20 feet west of wreck No. 2 and reaching to within about 20 feet from the shore.

Wreck No. 4 (name unknown) was found to have a fairly solid sternpost and keel, the rest of the ribs and hull (about 110 feet in length and 20 feet in breadth) being rather rotten, the whole being well sanded up inside, and showing no indications of cargo; its ribs rising to slightly above low-water mark; the wreck lying in from 4 to 8 feet depth of water a few feet west of wreck No. 3 and about 20 feet from the shore.

Wreck No. 5 (name unknown) was found to have its hull (about 75 feet in length and 20 feet in breadth) still tolerably solid and still full of lime; its ribs rising slightly above low water; the wreck lying in from 2 to 4 feet of water about 300 to 400 feet northwest of wreck No. 4, about 60 feet southeast of the steamboat wharf and about 20 feet from the shore.

Wreck No. 6 (name unknown) was found to consist of a wooden bottom (of about 150 feet length and 25 feet breadth), upon which still remained from 1 to 2 feet of the old lime cargo, the wreck having about 15 feet depth of water over this lime, and lying in from 16 to 18 feet depth of water just at the head of the deep-water channel at a point 150 feet northwest of the end of Beach Wharf on the eastern side of the head of the harbor. The lump formed by the old cargo had several times been struck by the keel and propellers of tugboats using this part of the harbor.

Wreck No. 7 (name unknown) was found to consist of an old wooden hull (about 120 feet in length and 20 feet in breadth), whose sternpost, side ribs, and 30 feet length of keel and old lime cargo were still remaining, the whole having only from 2 to 4 feet of water over the lime, and lying in from 5 to 7 feet depth of water, at a point about 6,000 feet from the head of the harbor and 300 feet from its western shore, and specially dangerous to light-draft boats approaching at high water the wharves and anchorages of this part of the harbor.

The location of all these wrecks is shown by sketches and maps now on file in this (Newport) office.

Field work upon these wrecks was commenced July 21, under Mr. Theo. McMahan, as diver and inspector, using a hired sailboat and crew, and was completed (together with other work) on August 3. The under-water work was all done in eight days, two other days being spent in waiting for suitable weather.

The lime cargoes were either scattered by explosives or washed out with a water jet, and then the hull and decks were shattered by explosives, the larger and more solid (together with some of the lighter) fragments being towed ashore and drawn up to above high-water mark, and the remaining portions being left scattered over the sand bottom in holes below the general surface of the bottom. In this work there were used, in all, 970 pounds of dynamite in 156 charges of from 2 to 20 pounds each, as follows: 290 pounds, in 45 charges, on wreck No. 1; 225 pounds, in 34 charges, on wreck No. 2; 179 pounds, in 25 charges, on wreck No. 3; 81 pounds, in 11 charges, on wreck No. 4; 33 pounds, in 13 charges, on wreck No. 5; 96 pounds, in 12 charges, on wreck No. 6; and 66 pounds, in 16 charges, on wreck No. 7.

Final inspections by diver and sounding poles after work at each wreck showed that everything had been removed to the general level of the surrounding bottom.

No property of any value was recovered, and no attempt was made to do so, since the cost of such work would have been greater than the value of the material saved (either through the direct expenses of such work or the delay thereby caused to the main work of destruction of the wrecks themselves).

The total cost of this work was $627.55, including all expenses of first examination, all field work, final inspections, and other superintendence, divided as follows: About $210 on No. 1, $100 on No. 2, $80 on No. 3, $70 on No. 4, $60 on No. 5, $50 on No. 6, and $60 on No. 7.

6. WRECK OF SCHOONER ACACIA.

The schooner *Acacia* was in August, 1893, reported as then lying in a wrecked condition, with her masts awash, near Chatham, Mass., in the main route of sailing and steam vessels around Cape Cod, and as therefore being a dangerous obstruction to navigation.

Under the provisions of section 4 of the river and harbor act of June 14, 1880, and by direction of the Secretary of War of August 18, 1893, and of the Chief of Engineers of same date, the work of the removal of this wreck was ordered, work to be done by hired labor and the use of the Government plant.

According to the best available reports, the schooner *Acacia*, bound from Port Johnson to St. Johns, New Brunswick, was on August 11, 1893, sunk by collision in a fog about 6 miles east southeast from Chatham, Mass. She was a small, 1-decked, 2-masted schooner, and when sunk was loaded with coal. Her dimensions were, approximately, as follows: Length, 49 feet; breadth, 13 feet; depth, 4 feet; gross tonnage, 31 tons; net tonnage, 29 tons. She was built in Essex, Mass., in 1884, and was documented from Marblehead, Mass. Before work was commenced upon her one topmast showed above water and the other was broken off, leaving the stump a few feet under the surface. She lay in about 70 feet of water directly in the course of vessels passing around Cape Cod. Owing to the depth of water around her the removal of her spars and rigging was all that was deemed necessary to prevent her from endangering or obstructing navigation.

Field work upon this wreck was commenced and finished on October 12, under Mr. Theo. McMahan, as diver, overseer, and inspector, using a small hired sailboat with crew. The sails and rigging were first cut loose from the hull and 7 pounds of dynamite were placed on her spars 50 feet below the surface. The explosion of this dynamite cleared away all obstructions down to 50 feet below the water level, the wreckage thus detached either sinking in deep water or floating off. This vessel is not now any obstruction to navigation.

No property of any value was recovered, nor was any attempt made to save any, since the cost of such work would have been greater than the value of the material saved (either through the direct expense of such work or the delay thereby caused to the main work of destruction of the wreck itself).

The total cost of this work was $117.26, including the expenses of location, field work of destruction, final inspection, and superintendence.

7. WRECK OF COAL BARGE N. & W. NO. 4.

The coal barge *N. & W. No. 4* was reported in August, 1893, as sunk and lying directly in the channel of Providence River, Rhode Island, above Sabines Point light-house.

Under provisions of section 4 of the river and harbor act of June 14, 1880, and by direction of the Secretary of War of August 29, 1893, and of the Chief of Engineers of August 30, 1893, the removal of this wreck was ordered, and $1,800 was allotted for this purpose, the work to be commenced as soon as possible after October 18, 1893, and to be done by hired labor and the use of the Government plant.

According to the best available information, this barge, loaded with coal, was sunk by collision at this place with the steamer *Berkshire* on August 18, and sank immediately in about 30 feet depth of water, directly in the middle of the narrow channel of this river, at a point about 350 yards above the Sabine Point light-house. She was a wooden 2-decked, 3-masted schooner barge, of 193 feet length, 37 feet breadth, 19 feet depth, built in 1890 at Brooklyn, N. Y., documented from Philadelphia, Pa., and owned by A. J. Hemphill. Lying directly in the middle of the channel, where she had to be passed many times each day and night, she was an exceedingly dangerous obstruction to the navigation of the river; but neither the State law nor the United States law provided for any removal within less than about sixty days, unless by the owner. Preparations were therefore made for prompt work by the United States force on the expiration of the two months limit of time, and the owner was so notified.

Meanwhile, on account of the value of the cargo, prompt work was being done by the owner and underwriters, and by October 6 their wrecking plant succeeded in raising the wreck and floating her off bodily to the nearest available wharf.

The work of the United States was therefore limited to a very small amount of correspondence, whose cost was so small as to be disregarded, the entire allotment being therefore returned to the Treasury untouched.

8. WRECK OF SCHOONER JOHN P. KELSEY.

A wreck (later stated to be the *John P. Kelsey*) was in September, 1893, reported as then lying in a wrecked condition, with her two masts awash, southeast of the Handkerchief light-ship and southwest of Monomoy Point Light, southern Cape Cod, Massachusetts, and as, therefore, being a dangerous obstruction to the navigation of this much-frequented water course around the southern end of Cape Cod.

Under the provisions of section 4 of the river and harbor act of June 14, 1880, and by direction of the Secretary of War of November 13, 1893, and of the Chief of Engineers of November 14, 1893, the removal of this wreck was ordered, work to be done by hired labor and the use of the Government plant.

Owing to the strong currents of this locality it was deemed best to not only remove all masts and rigging, but to thoroughly break up the hull, so that the latter could not be afterwards washed up into shoaler water, where it might become a new obstruction to navigation.

According to the best available reports, the schooner *John P. Kelsey*, bound from Rockland, Me., to New York City with a cargo of lime, took fire, was abandoned by her crew, and sank, in September, 1893, in about 36 feet of water, at a point about 1.9 miles east, 12° south of the then position of Handkerchief light-ship, and about 4.5 miles south

28° 42′ west of Monomoy Point (Massachusetts) Light. She was a wooden, 2-masted, 1-decked schooner of 170 tons gross and 161 tons net tonnage, of 100 feet length, 30 feet breadth, and 8.6 feet depth. She was built in 1872 at Estelville, N. J., was documented from Rockland, Me., and was recently owned by John Burnet. Before work was commenced upon her her foremast and fore-topmast were visible above water.

Field work upon this wreck was begun on January 5, 1894, and completed on January 10, 1894, under Mr. Theo. McMahan, as diver, overseer, and inspector, using a small hired sailboat with crew. The actual work of removal required two days, the other three days being occupied with preparations and closing work. An under-water examination showed that the hull lay in a hole about 10 feet deeper than the surrounding ocean bottom, which was about 30 feet below low water. About 100 pounds of dynamite were used to shatter the wreck and its rigging and scatter the cargo, etc., over the ocean bottom. Upon further submarine examination it was found that she was completely broken up, that there was more water over the fragments than over the adjacent sand bottom, and that there was nothing left which could again become any obstruction to navigation.

No property of any value was recovered, nor was any attempt made to save any, since the cost of such work would have been greater than the value of the material saved (either through the direct expense of such work or the delay thereby caused to the main work of destruction of the wreck itself).

The total cost of this work was $271.77, including all the expenses of location, field work of destruction, final inspection, and superintendence.

9. WRECK OF SCHOONER G. M. FARNSWORTH.

The schooner *G. M. Farnsworth* was reported in October, 1893, as then lying in a wrecked condition in Chatham Roads, Massachusetts, and as being a dangerous obstruction to navigation.

Under the provisions of section 4 of the river and harbor act of June 14, 1880, and by direction of the Secretary of War of November 13, 1893, and of the Chief of Engineers of November 14, 1893, the work of the destruction and removal of this wreck was ordered, work to be done by hired labor and the use of the Government plant.

According to the best available reports, the schooner *G. M. Farnsworth*, a wooden vessel, with 1 deck and 2 masts, loaded with lime, on her way from Rockland, Me., to New York City, was sunk in about 1858 on the flats west of Monomoy. She was about 80 feet long and 75 to 100 tons burden. When reported to this office she lay in Chatham Roads at a point about 2.8 miles southwest from Stage Harbor (Chatham Old Harbor) Light and about 1.2 miles from the nearest land, and in about 5 to 10 feet of water, a menace to all vessels entering Stage Harbor.

It was deemed best, therefore, to destroy her down to the level of the surrounding ocean bottom, about 9 to 10 feet below mean low water.

Field work upon this wreck was begun on January 1, 1894, and completed January 3, 1894, under Mr. Theo. McMahan, as diver, overseer, and inspector, using a small hired sailboat with crew. The actual underwater work was done in two days, the other day being spent in preparations and waiting for favorable weather. The hull and cargo were broken up and scattered by 153 pounds of dynamite in 36 charges.

The wreckage either floated away or was so scattered over the surrounding ocean bottom that it is now no longer an obstruction to navigation.

No property of any value was recovered, nor was any attempt made to save any, since the cost of such work would have been greater than the value of the material saved (either through the direct expense of such work or the delay thereby caused to the main work of destruction of the wreck itself).

The total cost of this work was $248.08, including all expenses of location, field work of destruction, and superintendence.

10. WRECK OF SCHOONER ANNIE W. AKERS.

The schooner *Annie W. Akers* was on January 20, 1894, reported as then lying in a wrecked condition in Hyannis Harbor, Massachusetts, west-southwest from the Old Colony Railroad Wharf, and as, therefore, being a dangerous obstruction to the free navigation of this harbor.

Under the provisions of section 4 of the river and harbor act of June 14, 1880, and by direction of the Secretary of War of January 24, 1893, and of the Chief of Engineers of the same date, the removal of this wreck by the United States was ordered and $950 was allotted for this purpose, work to be done by hired labor and the use of the Government plant.

According to the best available information, the English schooner *Annie W. Akers*, bound for New York City with a cargo of laths, was towed into Hyannis Harbor full of water November 12, 1893, and soon afterwards sank in about 9 feet of water, about 700 feet west-southwest from the Old Colony Railroad Wharf and about 1,100 feet from shore. She was a wooden, 2-masted, 1-decked schooner, of foreign build and register, of 109 tons burden, and of about 80 feet length and 18 feet breadth. As she was in a sinking condition when towed into Hyannis Harbor, Massachusetts, and as she was sold at auction to Mr. E. P. Cook, of Wellfleet, Mass., who stripped everything of value and abandoned her, leaving her to remain a dangerous obstruction to other shipping, such abandonment became a violation of Massachusetts State law, and the harbor and land commissioners of Massachusetts proceeded against the captain (Benj. Mallows) of the tug that towed the derelict into port and against E. P. Cook, the purchaser, as parties responsible for this obstruction. However, as those men were without special funds or property, and it was therefore doubtful whether the provisions of the State statute could be enforced without great delay, if at all, the actual removal of the wreck was finally undertaken by this office at the request of the Massachusetts State commissioners. Before work was commenced upon her her hull was partly visible above ordinary high water. The removal of her hull and all projecting parts down to the level of the ocean bottom was deemed necessary to prevent her from further endangering and obstructing navigation.

Field work upon this wreck was begun on the 3d and completed on the 7th March, 1894, under Mr. Theo. McMahan, as diver, overseer, and inspector, using a small hired sailboat with crew. The actual underwater work was done in three days. Sixty charges of dynamite, amounting to 401 pounds in all, were placed in different parts of the wreck by the diver and electrically exploded, completely breaking up the wreck and scattering the fragments over the surrounding ocean bottom; and any large pieces not floating off were carried up on the beach above high water, so that nothing was left projecting above the bottom to obstruct navigation in any way. This wreck is therefore no longer any obstruction to navigation. Soundings showed from 10 to 14 feet depths over the area formerly occupied by the wreck.

No property of any value was recovered, nor was any attempt made to save any, since the cost of such work would have been greater than the value of the material saved (either through the direct expense of such work or the delay thereby caused to the main work of destruction of the wreck itself).

The total cost of this work was $247.14, including all the expenses of location, field work of destruction, final inspection, and superintendence.

11. WRECK OF SCHOONER STEPHEN RAYMOND.

The schooner *Stephen Raymond* was, on January 20, 1894, reported as then lying in a wrecked condition in Hyannis Harbor, Massachusetts, west of the Old Colony Wharf and 300 yards from shore, and as, therefore, being a dangerous obstruction to the free navigation of this harbor.

Under the provisions of section 4 of the river and harbor act of June 14, 1880, and by direction of the Secretary of War of March 22, 1894, and of the Chief of Engineers of same date, the work of the removal of this wreck was ordered, and $500 was allotted for this purpose; work to be done by hired labor and the use of the Government plant.

According to the best available information, the schooner *Stephen Raymond*, bound from New York to Osterville, Mass., was wrecked about November, 1893, and sank in about 5 to 8 feet of water about 43 yards west of the Old Colony Wharf and 300 feet from shore, in Hyannis Harbor, Massachusetts. She was a small 1-decked, 2-masted, wooden schooner, and when sunk was loaded with coal. Her dimensions were approximately as follows: Length, 55 feet; breadth, 22 feet; depth, 4.4 feet; gross tonnage, 33 tons; net tonnage, 31 tons. She was built in Darien, Conn., in 1851, and was documented from Barnstable, Mass. Before work was commenced upon her parts of her hull showed above ordinary high water. She lay in about 5 to 8 feet of water in the way of small, light-draft vessels making use of this harbor. The removal of her hull and all projecting parts down to the level of the harbor bottom was deemed necessary to prevent her from further endangering and obstructing navigation.

Field work upon this wreck was commenced on the 28th March and finished on February 12, 1894, under Mr. Theo. McMahan, as diver, overseer, and inspector, using a small hired sailboat with crew. The actual under-water work was done in three days; the rest being spent in waiting for good weather. Forty-six charges of dynamite, amounting in all to 142 pounds, were placed in different parts of the wreck by the diver and electrically exploded, completely breaking up the wreck and scattering the fragments over the surrounding harbor bottom, so that nothing was left projecting above the bottom to obstruct navigation in any way. This wreck is therefore no longer any obstruction to navigation.

No property of any value was recovered, nor was an attempt made to save any, since the cost of such work would have been greater than the value of the material saved (either through the direct expense of such work or the delay thereby caused to the main work of destruction of the wreck itself).

The total cost of this work was $291.69, including the expenses of location, field work of destruction, final inspection, and superintendence.

12. WRECK OF SCHOONER KATIE MITCHELL.

The schooner *Katie Mitchell* was on January 20, 1894, reported as then lying in a wrecked condition on a bar southwest of Bass River, Massachusetts, east of Great Island and southeast of Hyannis, Mass., in the route of shallow-draft sailing and steam vessels, and as, therefore, being a dangerous obstruction to the free navigation to this vicinity.

Under the provisions of section 4 of the river and harbor act of June 14, 1880, and by direction of the Secretary of War of January 24, 1893, and of the Chief of Engineers of same date, the work of the removal of this wreck was ordered, and $950 was allotted for this purpose; work to be done by hired labor and the use of the Government plant.

According to the best available information, the schooner *Katie Mitchell*, bound from Bangor, Me., to New York, foundered during August, 1893, in about 8.5 feet of water on the edge of a bar about 2 miles southwest of Bass River, Massachusetts, about 1 mile east of Great Island, and about 3 miles southeast of Hyannis, Mass. She was a small, 1-decked, 2-masted, wooden schooner, and when sunk was loaded with lumber. Her dimensions were approximately as follows: Length, 84 feet; breadth, 26 feet; depth, 7 feet; gross tonnage, 113 tons; net tonnage, 107 tons. She was built in Bath, Me., in 1871, and was documented from Bath, Me. Before work was commenced upon her, her hull showed above ordinary high tide and lay in about 8.5 feet of water, in the course of vessels using this neighborhood. The removal of her hull and all projecting parts down to the level of the ocean bottom was deemed necessary to prevent her from further endangering and obstructing navigation.

Field work upon this wreck was commenced on the 13th of March and finished on February 17, 1894, under Mr. Theo. McMahan, as diver, overseer, and inspector, using a small hired sailboat with crew. The actual under-water work was done in two days. By the time that the field party reached this wreck on the second day, heavy sea action had already broken the schooner in two and drifted one half of the hull way up on the beach and the other half within 150 feet of the beach. Thirty charges of dynamite, amounting to 315 pounds in all, were placed in different parts of the wreck by the diver and electrically exploded, completely breaking up the wreck and scattering the fragments over the surrounding ocean bottom, after which all remaining large pieces of the wreck and cargo around both its original and last positions were carried up on the beach, so that nothing was left projecting above the bottom to obstruct navigation in any way. This wreck is therefore no longer any obstruction to navigation.

No property of any value was recovered, nor was an attempt made to save any, since the cost of such work would have been greater than the value of the material saved (either through the direct expense of such work or the delay thereby caused to the main work of destruction of the wreck itself).

The total cost of this work was $304.49, including the expenses ot location, field work of destruction, final inspection, and superintendence.

13. WRECK OF SCHOONER FRANKLIN.

The schooner *Franklin* was reported on January 20, 1894, as then lying in a wrecked condition on Bearses Shoal, southeast by east from Monomoy Light, southern Cape Cod, Massachusetts, and as being a dangerous obstruction to navigation.

Under the provisions of section 4 of the river and harbor act of June 14, 1880, and by direction of the Secretary of War of January 24, and of the Chief of Engineers of the same date, the work of the destruction and removal of this wreck was ordered, and $1,700 was allotted for this purpose; work to be done by hired labor and the use of the Government plant.

According to the best available information, the schooner *Franklin*, a wooden vessel with 1 deck and 2 masts, of 295 tons gross, and 280 tons net tonnage, loaded with paving stone, bound from Sullivan, Me., to New York City, was sunk on November 26, 1893, in 11 to 13 feet of water, on Bearses Shoal, about 0.5 mile southeast by east from Monomoy Light and about 0.5 mile north-northeast from Shovelful lightship. She was built in Baltimore, Md., in 1867, documented in Bath, Me., and was about 112 feet long, 30 feet broad, and 8 feet deep, and in good condition.

Before work was commenced on her her rigging showed above ordinary high tide, and there was from 5 to 8 feet over her decks. She lay in a very exposed place, where work of removal was possible only a few hours each day, owing to heavy seas and swift tidal currents, and where she was a constant danger to vessels needing to use this vicinity. The removal of her hull and all projecting parts down to the level of the ocean bottom was deemed necessary to prevent her from further endangering and obstructing navigation.

Field work upon this wreck was begun on February 19, 1894, and completed March 17, 1894, under Mr. Theo. McMahan, as diver, overseer, and inspector, using a small hired sailboat with crew. The actual under-water work was done in seven days; the other days being spent in preparations, and especially waiting for favorable weather and suitable tides. The hull and cargo were broken up and scattered by 380 pounds of dynamite in 71 charges. The wreckage either floated away or was so scattered over the surrounding ocean bottom that it is now no longer an obstruction to navigation. Soundings showed a least depth of 11 feet around the former place of the wreck.

No property of any value was recovered, nor was any attempt made to save any, since the cost of such work would have been greater than the value of the material saved (either through the direct expense of such work or the delay thereby caused to the main work of destruction of the wreck itself).

The total cost of this work was $682.72, including all expenses of location, field work of destruction, and superintendence.

14. WRECK OF SCHOONER LAURA E. MESSER.

The schooner *Laura E. Messer* was, on January 20, 1894, reported as then lying in a wrecked condition on the shoals of Pollock Rip, east of Monomoy Point, in the route of shallow-draft sailing and steam vessels, and as therefore being a dangerous obstruction to the free navigation of this vicinity.

Under the provisions of section 4 of the river and harbor act of June 14, 1880, and by direction of the Secretary of War of January 24, 1894, and of the Chief of Engineers of the same date, the work of the removal of this wreck was ordered, and $1,200 was allotted for this purpose; work to be done by hired labor and the use of the Government plant.

According to the best available information, the schooner *Laura E. Messer*, bound from Baltimore, Md., to North Weymouth, Mass., was wrecked January 11, 1894, by striking the shoals of Pollock Rip, and sank in about 10 to 15 feet of water at a point about 2.37 miles, southeast ½ east, from the Monomoy (Mass.) Life-Saving House, being about 1.75 miles from the nearest shore, that of Monomoy Point, Massachusetts. She was a wooden schooner of 2 decks and 3 masts, and of the following dimensions: Length, 137.7 feet; breadth, 32 feet; depth, 14.6 feet; and of 426.7 tons gross and 404.94 tons net tonnage. She was built in 1873 at Belfast, Me., and was documented from Rockland, Md., and was recently owned by J. F. Gregory. When first located, she had been stripped of her sails and some of her rigging and had already been partly broken up by the heavy seas, and she lay with 3 to 5 feet of water over her in about 12 feet of water, in the course of vessels using this neighborhood. The removal of her hull and all projecting parts down to the level of the surrounding ocean bottom was deemed necessary to prevent her from further endangering and obstructing navigation.

Field work upon this wreck, much delayed by bad weather, was commenced on March 18 and finished on April 4, 1894, under Mr. Theo. McMahan as diver, overseer, and inspector, using a small hired sailboat with crew. The actual under-water work was done in two days. By the time that the field party reached this wreck heavy sea action had already broken the schooner in pieces and drifted away the fragments, leaving only her chains, anchors, and heavy rigging on the ocean bottom. The dangerous location and character of this wreck made it important that its complete removal should be obtained beyond question of doubt, and therefore the adjacent ocean bottom was carefully examined by the aid of sweep lines and the diver over an area of about 750 yards square. Nothing large was found remaining. Anchor flukes and other small projections above the general bottom were removed so as to leave at least 12 feet of water all over a smooth sand bottom surface. This wreck is therefore no longer any obstruction to navigation.

No property of any value was recovered, nor was any attempt made to save any, since the cost of such work would have been greater than the value of the material saved (either through the direct expense of such work or the delay thereby caused to the main work of destruction of the wreck itself).

The total cost of this work was $443.15, including the expenses of location, field work, final inspection, and superintendence.

15. WRECK OF SCHOONER ASA H. PERVERE.

The schooner *Asa H. Pervere* was, on March 20, 1894, reported as then lying in a wrecked condition off Monomoy Beach, Massachusetts, and as therefore being a dangerous obstruction to the free navigation of this harbor.

Under the provisions of section 4 of the river and harbor act of June 14, 1880, and by direction of the Secretary of War of March 22, 1894, and of the Chief of Engineers of the same date, the work of the removal of this wreck was ordered, and $350 was allotted for this purpose; work to be done by hired labor and the use of the Government plant.

According to the best available information, the schooner *Asa H. Pervere*, bound from Swan's Island, Maine, to New York City, was wrecked and sunk several years ago. Later the sand washed off from and around her so as to change her former condition, and left her lying in about 6 feet of water, about 2.9 miles south-southwest of the Chatham Lights, and 2.25 miles northeast half east from Monomoy Life-Saving

Station, and about 200 yards from the shore of Monomoy Beach, Massachusetts. She was a small 1-decked, 2-masted, wooden schooner, and when sunk was loaded with stone. Her dimensions were approximately as follows: Length, 86.5 feet; breadth, 23.5 feet; depth, 8 feet; gross tonnage, 98 tons. She was built in Essex, Mass., in 1876, and was documented from Wellfleet, Mass. Before work was commenced upon her, parts of her hull showed above very low water. She lay in about 6 to 8 feet of water, in the way of small light-draft vessels making use of this neighborhood, had actually been struck by one of the small light-draft fishing boats of the vicinity, and was also a constant element of danger to the boats of the Life-Saving Station, especially in foggy or bad weather and at night. She had been considerably broken up by the sea, but the greater part of her hull still remained. The removal of her hull and all projecting parts down to the level of the ocean bottom was deemed necessary to prevent her from further endangering and obstructing navigation.

Field work upon this wreck was commenced on March 28, 1894, and finished on the same day, under Mr. Theo. McMahan, as diver, overseer, and inspector, using a small hired sailboat with crew. Twenty-five charges of dynamite, amounting in all to 75 pounds, were placed in different parts of the wreck by the diver and electrically exploded, completely breaking up the wreck and scattering the fragments over the surrounding ocean bottom, so that nothing was left projecting above the bottom to obstruct navigation in any way. This wreck is therefore no longer any obstruction to navigation.

No property of any value was recovered, nor was any attempt made to save any, since the cost of such work would have been greater than the value of the material saved (either through the direct expense of such work or the delay thereby caused to the main work of destruction of the wreck itself).

The total cost of this work was $82.13, including the expenses of location, field work of destruction, final inspection, and superintendence.

16. WRECK NEAR BROWNS LEDGE, MASSACHUSETTS.

Between November, 1893, and May, 1894, various reports continued to be heard as to an unknown wreck whose mast or spar projected from 3 to 8 feet above the water, at a point somewhere within an area of about a mile diameter and about 2.5 to 3.5 miles north of Browns Ledge, western entrance to Vineyard Sound, Massachusetts, where the water is reported to be about 12 to 16 fathoms deep. Any wreck of this nature in this locality being evidently a danger to navigation, her continued existence was duly reported to the Department, and by direction of the Secretary of War of May 12, 1894, and of the Chief of Engineers of same date, the destruction of her masts and rigging to 30 feet depth below the water surface was ordered; work to be done by hired labor and the use of the Government plant.

However, before the engineer force and plant could be spared from other work and sent to this locality, further report was received from the Navy Department that its dynamite cruiser *Vesuvius* had found this wreck and destroyed its masts and rigging to about 60 feet depth, leaving nothing further to be done.

The work of the engineer office was therefore limited to correspondence and other office work to the extent of only $8.34.

17. WRECK OF SCHOONER L. F. HOPKINS.

This wreck was reported in May as sunk across the main channel of the Pawtucket River, near its head. Reports were submitted thereon on May 26. By direction of the Secretary of War of May 29, allotment was made and her removal ordered, work to be commenced on July 16. A bill was secured from the Rhode Island legislature by which this (and all future similar wrecks, in cases of emergency) may be removed at once under the direction of the State harbor commission, and at the expense of the parties at fault, or by the State. Preparations were made for further work.

18. WRECK NEAR PARKER'S RIVER.

This wreck was reported to this office during the month of June as having been run into by private boat owners, with serious results to their boats. The existence and extent of this wreck were inquired into. Preparations were made for further work.

APPENDIX D.

IMPROVEMENT OF CONNECTICUT RIVER, MASSACHUSETTS AND CONNECTICUT, OF RIVERS AND HARBORS ON LONG ISLAND SOUND, CONNECTICUT AND NEW YORK, AND ON SOUTHERN SHORE OF LONG ISLAND, NEW YORK.

REPORT OF LIEUT. COL. HENRY M. ROBERT, CORPS OF ENGINEERS, OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1894, WITH OTHER DOCUMENTS RELATING TO THE WORKS.

IMPROVEMENTS.

1. Mystic River, Connecticut.
2. Thames River, including Shaws Cove, New London Harbor, Connecticut.
3. Connecticut River, Massachusetts and Connecticut.
4. Harbor of refuge, Duck Island Harbor, Connecticut.
5. Clinton Harbor, Connecticut.
6. New Haven Harbor, Connecticut.
7. Breakwaters at New Haven, Connecticut.
8. Milford Harbor, Connecticut.
9. Housatonic River, Connecticut.
10. Bridgeport Harbor, Connecticut.
11. Black Rock Harbor, Connecticut.
12. Saugatuck River, Connecticut.
13. Wilsons Point Harbor, Connecticut.
14. Five Mile River Harbor, Connecticut.
15. Stamford Harbor, Connecticut.
16. Harbor at Cos Cob and Mianus River, Connecticut.
17. Port Chester Harbor, New York.
18. Larchmont Harbor, New York.
19. East Chester Creek, New York.
20. Greenport Harbor, New York.
21. Port Jefferson Harbor, New York.
22. Huntington Harbor, New York.
23. Glen Cove Harbor, New York.
24. Flushing Bay, New York.
25. Patchogue River, New York.
26. Browns Creek, Sayville, N. Y.
27. Removing sunken vessels or craft obstructing or endangering navigation.

HARBOR LINES.

28. Greenport Harbor, New York.
29. Patchogue River, New York.

ENGINEER OFFICE, U. S. ARMY,
New York, N. Y., July 9, 1894.

GENERAL: I have the honor to transmit herewith the annual reports upon the works of river and harbor improvement under my charge for the fiscal year ending June 30, 1894.

Very respectfully, your obedient servant,

HENRY M. ROBERT,
Lieut. Col., Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

D I.

IMPROVEMENT OF MYSTIC RIVER, CONNECTICUT.

Mystic River is a narrow tidal stream in the eastern part of the State of Connecticut, about 7 miles west from the boundary of the State of Rhode Island. The navigable part of the river extends in a general north-northeasterly direction for nearly 4 miles from Fishers Island Sound, past the villages of Noank, West Mystic, and Mystic, above which places it receives the discharge of several small fresh-water streams. The village of Mystic lies on both the east and west banks of the river, about 3 miles above Fishers Island Sound; at this point the river is crossed by a highway bridge with a draw. Nearly a half mile farther down is the drawbridge of the New York, Providence and Boston Railroad, and about 1½ miles still farther the village of Noank lies upon the west bank. West Mystic is a small settlement and railroad station a short distance back from the west bank of the river and between Mystic and Noank. The population of Mystic and West Mystic together is about 4,000; that of Noank about 2,000.

Directly opposite the mouth of the river lie Mystic or Ram Island and Ram Island Shoal, which cause the channel to divide and branch off sharply to the northeast and southwest. The northeast channel is 18 feet or more in depth and of sufficient width, but crooked; it is the one used by large vessels. The southwest channel opens out into a broad flat, with about 12 feet available depth.

The river channel up to within about a half mile below the highway bridge had a natural low-water depth of 15 feet or more; its width, from 80 to 300 feet, was sufficient, but there were several bends in its course, which made it somewhat difficult of navigation. The mean rise of tide in Mystic River is about 2½ feet.

PROJECT OF IMPROVEMENT.

Under act of Congress of August 11, 1888, a preliminary examination of Mystic River was made. In the report on this examination, dated October 26, 1888, and printed in the Annual Report of the Chief of Engineers for 1889, Part I, page 746, a project for improvement was submitted, which consisted in dredging to make the channel 15 feet deep at mean low water and 100 feet wide and to reduce five bends in the channel. The estimate of cost, based upon the U. S. Coast Survey chart of 1882, was as follows:

160,000 cubic yards, at 16 cents	$25, 600
Supervision and contingencies, say	4, 400
Total	30, 000

The beginning of work under this project was approved by the Secretary of War November 1, 1890, after the first appropriation for improving the river had been made. Up to July 1, 1893, 98,034 cubic yards of sand and mud had been dredged, and the channel had been completed as designed from the highway bridge at Mystic down to and including the first bend, being 15 feet deep at mean low water and 100 feet wide, with greater width at the bend. At the second bend work was partly completed, and the channel was 100 feet wide; at the third and fourth bends, opposite Sixpenny Island, no work had been done. At the fifth, or lowest, bend the channel had been widened from 25 to 75 feet; it was intended to widen it further, but ledge rock was encountered.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1894.

At the beginning of the year work under an open-market agreement, authorized by the Chief of Engineers December 2, 1892, had been suspended. It was intended to resume work early in August, 1893, but on account of pressing urgency for completion of other work by the same contractors the dredging in Mystic River was further deferred, and was resumed April 4, 1894, and completed May 1, 1894. The total amount removed during the fiscal year was 20,000 cubic yards of mud; 938 cubic yards were dredged to remove a small shoal just above the first or uppermost of the five bends; 10,351 cubic yards were dredged to complete the widening of the second bend, making it 300 feet wide; 8,711 cubic yards were dredged from the upper part of the bend opposite Noank. The depth made was 15 feet at mean low water.

An examination of the dredged areas below the railroad bridge and of the rock at the lowest bend was made, but the results are not yet platted.

PRESENT CONDITION OF IMPROVEMENT.

The channel is completed as designed from the highway bridge at Mystic down to and including the second bend, being 15 feet deep at mean low water and 100 to 300 feet wide or more at the bends. At the third and fourth bends, opposite Sixpenny Island, no work has yet been done; at and above the fifth or lowest bend the channel has been widened from 25 to 75 feet.

PROPOSED OPERATIONS.

Future appropriations will be applied to widening and reducing the bends in the channel and to maintaining the depths already made.

The average annual cost of maintenance of channels in Mystic River is estimated at $2,000.

Appropriations for the improvement of Mystic River, Connecticut, have been made as follows:

Application.	Date.	Amount.
Dredging above and just below railroad bridge and at the mouth of the river.	Sept. 19, 1890	$10,000
Dredging below railroad bridge	July 13, 1892	10,000
Total		20,000

Mystic River is in the New London collection district, of which New London is the port of entry.

The nearest work of defense is Fort Griswold, New London Harbor, about 6 miles west. There is a light-house on Morgan Point, on the west side of the river, at its mouth.

Money statement.

July 1, 1893, balance unexpended	$3,649.03
June 30, 1894, amount expended during fiscal year	3,378.64
July 1, 1894, balance unexpended	270.39
Amount (estimated) required for completion of existing project	10,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

COMMERCIAL STATISTICS FOR CALENDAR YEAR 1893.

Commercial statistics have been asked for, but up to date of this report have not been received.

D 2.

IMPROVEMENT OF THAMES RIVER, CONNECTICUT.

This river is formed by the confluence of the Yantic and Shetucket rivers at Norwich, Conn., and extends southward as a tidal stream 15 miles to Long Island Sound. For 11 miles above its mouth the natural channel is from 13 to 80 feet deep, averaging over 30 feet for the first 4 miles. For 3 miles below Norwich the available depth in 1829 was but 6 feet at mean low water where now there is 11 feet. Histories of the improvements of this river near Norwich, Conn., may be found in the Annual Report of the Chief of Engineers for 1873, p. 981, and in that for 1879, part 1, p. 331.

Shaws Cove, New London Harbor, is a cove on the west side of Thames River, about 2 miles above its mouth, and constitutes the southern water front of the business portion of the city of New London. It is separated from the river by the embankment and trestle of the Shore Line Division of the New York, New Haven and Hartford Railroad, having a draw of 55 feet width. The natural depth in Shaws Cove was from 2½ to 8 feet at mean low water in a narrow and crooked channel bordered by flats.

The mean rise of tide in the Thames River near Norwich is about 3.1 feet; at New London it is 2.5 feet.

PROJECTS FOR IMPROVEMENT.

Prior to 1830 various attempts had been made by private parties and corporations to deepen the channel of this river near Norwich; the first ones were by excavation only, but subsequently stone piers were constructed perpendicular to the channel at shoal spots.

By act of March 2, 1829, Congress appropriated $150 "for making a survey of the river Thames, with a view to improve the navigation of the same, and the cost of such improvement."

The survey was made in 1829 by Capt. Hartman Bache, Corps of Engineers. At that time there were four old piers standing. In his report upon the survey, dated February 20, 1830, and printed in House of Representatives War Department Doc. No. 125, Twenty-first Congress, first session, Captain Bache submitted a project for making a channel 60 feet wide, to be either 12 or 14 feet deep at high water (9 or 11 feet at low water), by excavation, by rebuilding one of the existing piers, by adding wings to the other three, extending up and down stream, and converting them into T walls, and by building ten new piers, extending down stream in curves. The piers were to be built of riprap, 3 feet wide on top, with side slopes of 45°; they were to be built to heights of from 1½ to 3½ feet above highest tide, those farthest up the stream being the highest. The piers were estimated to require 43,436 cubic yards of riprap, and the excavation was placed at 27,895 cubic yards for the 12-foot channel or 69,251 cubic yards for the 14-foot channel. The cost of the whole work was estimated at $72,650.

The project was adopted, and under appropriations of 1836, 1837, and 1838, $40,000 in all, the piers were built nearly as designed, with the exception of two of the new piers and one wing wall, which were not constructed; considerable dredging was done, but no complete records of amount appear to have been kept.

Work was stopped in 1839 by exhaustion of appropriations.

In 1866 a petition of citizens of Norwich, asking for an appropriation for removing obstructions in the river Thames, was referred to the

Chief of Engineers, and returned by him to the Secretary of War with a report describing the work done upon the river, recommending no further work upon the piers until their efficiency could be investigated satisfactorily, and stating:

> In conclusion, it is considered that, should the sum of $8,000 be appproprinted for the improvement of this river, to be applied during the next fiscal year, all will be accomplished that can be justifiably undertaken until a commission decides upon other efficacious methods or systems of improvement.

June 23, 1866, an appropriation of $10,000 was made for improving the river, under which a survey was made, and a project for dredging to obtain 11 feet at low water (14 feet at high water) was adopted.

Under this and succeeding appropriations up to 1878 this channel was dredged, and, as far as possible, maintained with a width of 100 feet. March 3, 1879, $12,000 was appropriated "for the improvement of Thames River to secure a 14-foot channel," and in accordance therewith the project was modified to provide for a channel of that depth at low water.

In 1882, upon the recommendation of Maj. Barlow, approved by the Board of Engineers, the project was further modified by providing for the construction of five dikes or training walls along the outer sides of the channel curves, with the addition of low walls on the inner side, should they be found necessary, the width of the water way between them increasing from 300 feet (about the full width of the river) at Thamesville, 1 mile below Norwich, to 480 feet at the lower dike.

The object of the training walls was to utilize the action of the tide to keep the channel open. They were to be built up to high-water level, and to have an aggregate length of 13,800 feet. In the same year the projected width of the channel was increased to 200 feet. The improvement was designed to extend over the first 3½ miles below Norwich, and the estimated cost was—

For the five dikes or training walls	$82,800
For dredging 200 feet wide and 14 feet deep	125,280
Total	208,080

Under several appropriations up to 1888 work was carried on under this project without modification.

In May, 1888, in response to a letter from the Hon. Charles Russell, M. C., to the Secretary of War, asking the "approximate cost of completing the 16-foot deep channel to Allyn Point, and the 14-foot deep channel to Norwich," estimates for the same were submitted as follows:

For securing, by dredging, a 16-foot channel up to Allyn Point	$24,000
For securing, by dredging, a 14-foot channel from Allyn Point to the end of the existing improvement	16,200

By act of Congress of August 11, 1888, an appropriation of $50,000 was made for continuing the improvement of Thames River, with a clause authorizing its expenditure "at any point between Norwich and New London." The project was therefore extended to include the above-described work and the estimate for completion was increased accordingly by $40,000, making it $95,600 in 1889.

By act of Congress approved September 19, 1890, an examination of Shaws Cove, New London Harbor, was ordered, which was made in the same year, and the report upon which, dated December 4, 1890, was printed in House Ex. Doc. No. 73, Fifty-first Congress, second session, and also in the Annual Report of the Chief of Engineers for 1891, p. 833 *et seq.*

This report stated the desired improvement, which consisted in making a channel 100 feet wide and 12 feet deep at mean low water, extending from the drawbridge along the north and west sides of the cove a total length of about 2,000 feet, and an anchorage basin in the bend of the channel of the same depth and about 400 by 800 feet.

The estimated cost was:

Dredging the channel, 90,000 cubic yards, at 18 cents	$16,200
Dredging the anchorage basin, 140,000 cubic yards, at 18 cents	25,200
Contingencies, etc	6,600
Total	48,000

The river and harbor act approved July 13, 1892, appropriated $30,000 for improvement of Thames River, Connecticut, with proviso that $10,000 of this sum might, in the discretion of the Secretary of War, be applied to improving that part of New London Harbor known as Shaws Cove. The expenditure of $10,000 for this work was approved by the Secretary of War July 23, 1892, in order to carry out part of the above plan of improvement. The establishment of harbor lines in Shaws Cove by the Secretary of War, January 26, 1893, necessitated a change in the dimensions of the anchorage basin, without, however, any material change in its available area (7½ acres) or in its estimated cost.

The existing project for this improvement is therefore the project of 1882 with two extensions, and it now consists in making and maintaining by dredging and a system of training walls a channel 200 feet wide from New London to Norwich, having 16 feet depth at mean low water up to Allyn Point (about 5 miles below Norwich), and 14 feet depth from Allyn Point to Norwich, together with dredging to make and maintain a channel in Shaws Cove, New London, 100 feet wide and 12 feet deep, and an anchorage basin near the bend of the channel of the same depth and of about 7½ acres area. The estimate for completion, $208,080, in 1882, is to be increased by the estimates for the added work, $88,000, and to be reduced by the $20,000 available in 1882, and $182,500 since appropriated, making the present estimate for completion $93,600.

From the beginning of work under this project to July 1, 1893, 426,858 cubic yards of sand, etc., had been dredged from the channels above Allyn Point, 84,890 cubic yards of sand and mud from the 16-foot channels at and below Allyn Point, and 52,120 cubic yards of sand and mud from Shaws Cove. The three dikes farthest down stream had been built, and a fourth one to about three-quarters its contemplated length. The river channel had been made the full depth and width up to Allyn Point. Above Allyn Point the 14-foot channel had been extended nearly half way to Norwich, the available depths in the upper part of the river being from 11 to 12 feet. In Shaws Cove the channel along the north and west sides of the cove had been made 60 feet wide, and the bend was dredged to 120 feet additional width as part of the projected anchorage ground, all with depth of 12 feet at mean low water.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1894.

At the beginning of the year dredging in the river near Norwich was in progress under a contract with the Hartford Dredging Company, for removing about 75,000 cubic yards of material, at 24½ cents per cubic yard. This work was continued until the contract was completed, August 16, 1893. The amount dredged during the fiscal year was 37,715 cubic yards. The channel of 14 feet depth was extended upstream to the "sand pier" (about 1½ miles below Norwich) with width of 100 feet and over, and shoals were removed to make the channel from the "sand pier" to Norwich 12 feet deep and fully 100 feet wide.

The total amount dredged under the contract was 75,015 cubic yards.

No work was done in Shaws Cove, the funds for that work having been expended. A wharf on the north side of the cove was built out beyond the harbor lines. The matter was placed in the hands of the Department of Justice, the owner of the wharf having refused to remove it, and he was compelled to take up that part of the wharf which was beyond the established harbor lines.

PRESENT CONDITION OF IMPROVEMENT.

Of the five dikes or training walls provided for in the project the four farthest downstream have been built at cost as follows:

	Date of completion.	Length.	Riprap, exclusive of repairs.	Cost, exclusive of supervision.
		Feet.	*Tons.*	
Mohegan, 3½ miles below Norwich	1883	2,988	(*)	$23,686.00
Trading Cove, 2½ miles below Norwich	1882	2,370	17,207	21,113.05
Long Rock, 2 miles below Norwich	1885	2,800	11,945	12,781.15
Rolling Mill, 1½ miles below Norwich	1887	3,093	18,521	18,772.58

* Pile dike.

The Rolling Mill Dike, originally designed to be 4,350 feet long, is now 3,093 feet long, with a gap of 390 feet at the "sand pier," and extends northward nearly to the Lower Rolling Mill embankment.

The project contemplated extending it about 600 feet north of the embankment, but since its adoption the Lower Rolling Mill Company has dredged a channel toward shore on the north side of their embankment, which is now used as a landing. It would be necessary to leave an opening for this channel, and probably it will be found expedient not to extend the dike above the embankment.

The upper dike, one-half mile below Norwich, has not been begun.

The low-water depth in the channel from New London to Allyn Point is not less than 16 feet, with width of 200 feet or over; from Allyn Point to the upper end of Walden Island Reach the depth is practically 14 feet and the width not less than 175 feet; above the latter point, the 14-foot depth with 100 feet width extends to the "Sand Pier," about 1½ miles below Norwich. For the upper 1½ miles of the river the available depth is 12 feet at mean low water.

The channel in Shaws Cove is 60 feet wide and 12 feet deep at mean low water, with 120 feet additional width at the bend of the channel. No work was done there during the past fiscal year.

The last sketches of this river published with Annual Reports of the Chief of Engineers are:

Shaws Cove, New London, Report of 1893, p. 904.
Thames River, full length, Report of 1889, p. 656.
Thames River near Norwich, Report of 1885, p. 640.

PROPOSED OPERATIONS.

Future appropriations will be applied to completing the dikes if necessary, and to making and maintaining a channel 200 feet wide, to be 16 feet deep at mean low water up to Allyn Point, and thence to Norwich to be 14 feet deep, and to completing the channel and anchorage basin in Shaws Cove, as provided in the approved project.

Appropriations for the improvement of Thames River have been made as follows:

Application.	Date.	Amount.
Removal of obstructions placed during the war of 1812	Mar. 3, 1821	$150
Survey	Mar. 2, 1829	150
Piers and dredging	July 4, 1836	10,000
Do	Mar. 3, 1837	20,000
Do	July 7, 1838	10,000
Dredging and survey	June 23, 1866	10,000
Dredging	Mar. 3, 1867	72,000
Do	Mar. 3, 1871	15,000
Do	June 10, 1872	10,000
Do	June 18, 1878	10,000
Do	Mar. 3, 1879	12,000
Do	June 14, 1880	22,500
Dredging and training walls	Mar. 3, 1881	30,000
Training walls	Aug. 2, 1882	*35,000
Do	July 5, 1884	*25,000
Training walls and dredging	Aug. 5, 1886	*22,500
Repair of training walls and dredging	Aug. 11, 1888	*50,000
Dredging	Sept. 19, 1890	*20,000
Do	July 13, 1892	*†30,000
Total		404,300

* Appropriated for present project; these, with $20,0000 from previous appropriations (see Annual Report for 1882, Part I, p. 603), make a total of $202,500 for present project.

† $10,000 of which was applied to Shaws Cove, New London Harbor.

The Thames River is in the collection district of New London. The nearest lighthouse is at the mouth of the river, on the west shore. Forts Trumbull and Griswold overlook the mouth of the river from either shore.

Money statement.

July 1, 1893, balance unexpended	$24,051.45
June 30, 1894, amount expended during fiscal year	21,090.41
July 1, 1894, balance unexpended	2,961.04
Amount (estimated) required for completion of existing project	93,600.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	50,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

Abstract of contract for improving Thames River, Connecticut, in force during the fiscal year ending June 30, 1894.

Name and address of contractor.	Date of contract.	Subject of contract.	Price per cubic yard.	Remarks.
The Hartford Dredging Company, Hartford, Conn.	October 20, 1892.	Dredging near Norwich, Conn.	$0.24½	Contract completed Aug. 16, 1893; total dredged, 75,015 cubic yards.

COMMERCIAL STATISTICS FOR THE CALENDER YEAR 1893.

AT NORWICH.

[By courtesy of M. M. Whittemore, treasurer Norwich and New York Transportation Company.]

Arrivals and departures of vessels.

Kind of vessels.	Number of round trips.
Steamers	1,042
Sailing vessels	257
Barges	471
Total	1,770

Aggregate tonnage of all trips not ascertained.

Freight received and shipped by water.

	Tons.
Total	546,900

No new lines of transportation have been established since July 1, 1893.

The year 1893 was not considered a fair average year, on account of the general business depression.

The aggregate tonnage of trips or estimated value of shipments can not be readily ascertained.

The tonnage of freight above reported shows a decrease of 62,668 tons since the calender year of 1891, the last year for which these statistics were reported.

AT SHAWS COVE, NEW LONDON.

[By courtesy of John Hopson, jr., New London, Conn.]

Arrivals and departures of vessels.

[Draft 3 to 11 feet; tonnage 12 to 250 tons.]

Kind of vessels.	Number.
Steamers	28
Sailing vessels	86
Barges	22

Aggregate tonnage of all trips not ascertained.

Freight received by water.

Chief articles.	Estimated value.
Lumber	$20,800
Coal	27,825
Brick	1,055
Miscellaneous (not otherwise included)	22,000
Total	71,680

Tonnage not ascertained.

No new lines of transportation have been established since July 1, 1893.

"Steam vessels and sail vessels laid up for the winter in Shaws Cove, occupying all the present docks and partly filling the channel, the outfitting and repairs on which vessels it is estimated has exceeded $18,600.

The anchorage basin should be excavated, and will be used to its fullest capacity. The prevailing business depression has diminished the business on and use of improvements in Shaws Cove fully one-half."

D 3.

IMPROVEMENT OF CONNECTICUT RIVER, MASSACHUSETTS AND CONNECTICUT.

This river rises in the northern part of New Hampshire, flows in a general southerly course between the States of New Hampshire and Vermont, crosses the States of Massachusetts and Connecticut, and empties into Long Island Sound at Saybrook Point, Connecticut. It is divided naturally into two parts, Hartford, Conn., at the head of navigation, being the point of division, and appropriations by Congress have generally specified in which part the money appropriated was to be expended.

The divisions are as follows:

1. *Above Hartford, Conn.*—Embracing a length of about 66 miles, from Hartford, Conn., to Millers Falls, Mass.

2. *Below Hartford, Conn.*—Embracing a length of about 50 miles, from Hartford to Long Island Sound.

By the river and harbor act of 1882 an examination or survey of the Connecticut River from Bellows Falls, Vt., to Pittsburg, N. H., was authorized. Bellows Falls is about 105 miles above Hartford, and Pittsburg is 180 miles above Bellows Falls. A preliminary examination was made, the report on which, printed in the Annual Report of the Chief of Engineers for 1884, part 1, p. 659, recommended no survey and proposed no plan of improvement.

1. ABOVE HARTFORD, CONN.

Millers Falls, Mass., is at the head of possible navigation of the Connecticut River. From this point down to Holyoke, Mass., a distance of about 32 miles, the river is susceptible of improvement, but it can not be used by vessels now on account of a dam and falls at Holyoke, which entirely obstruct navigation. The lockage required to lift boats from the lower to the upper levels at Holyoke is about 60 feet.

From Holyoke, Mass., to Enfield Falls, Conn., a distance of 18 miles, there is a fair channel, 4 to 5 feet deep at low water, which could be made 8 feet deep. Enfield Falls or Rapids cover a stretch of river about 5 miles long, having a fall of about 32 feet at low water. The bed is rocky and very uneven, and the slope is not uniform, but consists of a succession of long, shallow reaches separated by rapids.

From the foot of Enfield Falls to Hartford, a distance of 11 miles, the river has a broad, sandy bed, with a depth of 2 to 5 feet at low water. Under a charter from the State of Connecticut, granted in May, 1824, the Connecticut River Company constructed a canal with locks around Enfield Falls. The locks are 80 feet long, 18 feet wide, and 4½ feet deep. The canal is chiefly used for water power; the company collects toll from vessels using it.

Following is a list of places in this part of the river where work has been done by the United States, with distances above the wagon bridge at Hartford:

	Miles.
Barbers Landing	4
Farmington River	5
Strongs Island	6¼
Scantic River	7¼

PROJECT FOR IMPROVEMENT.

No general project for the improvement of this part of the river is on record as approved and adopted. All the work done has been under special projects for expenditure of the several appropriations. It consists of dredging at Barbers Landing in 1873, and construction of dikes or wing dams at Scantic River, Strongs Island, and Farmington River in 1871, at Farmington River and Barbers Landing in 1878, and again in 1880 and 1881.

Plans and estimates for a larger canal around Enfield Falls were submitted in 1878 and modified in 1880. (See Annual Report of the Chief of Engineers for 1881, Part I, p. 566.) They proposed a canal on the east bank of the river, extending from above Enfield Falls down to the mouth of Hockanum River, opposite and just below Hartford, as the best means of gaining an available depth of 8 feet from Hartford to and around the falls. The canal levels were to be 10 feet deep at low water and 120 feet wide at the water line; the locks 200 feet long, 55 feet wide, with 8 feet depth over the miter sills at low water. The cost of the work was estimated at $1,332,805. It was considered not advisable to begin construction with a less sum than $450,000.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1894.

No work was done. The available money is insufficient to begin any general plan of improvement in this part of the river.

PRESENT CONDITION OF IMPROVEMENT.

The wing dams are all in fair condition; they are as follows: One at Scantic River, one at Strongs Island, one at the mouth of Farmington River, two nearly opposite the mouth of Farmington River, and two on the east bank, opposite Barbers Landing. The available channel depth from Hartford to Scantic River is about 2 feet at ordinary summer stage of water; this part of the river is navigable for freighting only when in freshets. No work has been done above Scantic River; the depth from there to the foot of Enfield Falls is greater than from there down to Hartford.

PROPOSED OPERATIONS.

No work in the river above Hartford is contemplated during the ensuing year. Should any injury to the wing dams occur the money available will be sufficient for repairs.

Appropriations for improving the Connecticut River above Hartford have been made as follows:

Application.	Date.	Amount.
Dams at Scantic River and Strongs Island, Farmington River, and Barbers Landing; repairs of dams; dredging at Barbers Landing; surveys	July 11, 1870	$20,000
	Mar. 3, 1871	20,000
	June 10, 1872	25,000
	Mar. 3, 1873	20,000
	June 14, 1880	15,000
Total		100,000

Of these amounts the following balance is as yet unexpended: From the appropriation of June 14, 1880, for "improving Connecticut River between Hartford and Holyoke," $8,940.30

Money statement.

July 1, 1893, balance unexpended	$8,940.30
July 1, 1894, balance unexpended	8,940.30

2. BELOW HARTFORD, CONN.

The Connecticut River below Hartford is a large stream, for the first 21 miles flowing in a winding course, mostly through alluvial meadows, which are overflowed at high water, and which consist of a light sandy soil, easily undermined. For the remaining 29 miles to Long Island Sound, at Saybrook Point, the course is straighter, the banks more permanent, and generally harder. A gauge has been established at Hartford whose zero is the lowest stage that the water is known to have reached from natural causes; closing the gates at the Holyoke Dam in time of drought has caused the water to fall lower.

The usual low-water stage of the river in the summer is about 1 foot on this gauge. Spring freshets ordinarily rise to 20 feet; the highest recorded stage of water is 29 feet.

The average tide at Saybrook is 3½ feet; at Hartford it is 1 foot, though when the water stands above 5 feet on the Hartford gauge the tide there is not perceptible. The low-water slope of the river from Hartford to Saybrook averages 0.0458 foot per mile. The bed of the river through the alluvial meadows within 10 miles of Hartford is constantly changing from the undermining of the banks. It is said that in places it has changed its position a half mile. The bars in this part of the river, after being dredged, form again during freshets and ice jams, so that some of them require being dredged annually, others less frequently. This part of the river was worked upon by corporations and by private parties at various times between 1800 and 1870. Several small stone piers to deepen the channel at shoal places were built in this way. Some of these are covered by new banks, the channel has shifted to the opposite side of others, and others still have been dredged out because they had come to be obstructions. The depth sought by these works was 6 feet at low water.

The following list gives the names of the several places on the river below Hartford where work has been done by the United States, with their distances by course of channel below the Hartford wagon bridge:

Locality.	Miles.	Locality.	Miles.
Hartford Bar	1½	Sears Shoal	26
Clay Banks Bar	2½	Haddam Island Bar	30
Pratt Ferry or Naubuc Bar	5½	Chester Rock	38
Press Barn Bar	6¾	Devils Reef Bar	39½
Glastonbury Bar	9½	Brockway Bar	41
Dividend Bar	12	Calves Island Bar	44½
Pistol Point Bar	15	Saybrook Bar (at mouth)	50
Mouse Island Bar	20½		

PROJECTS FOR IMPROVEMENT.

By act of July 4, 1836, Congress appropriated $20,000 "for improving the harbor at Saybrook, by removing the bar at the mouth of the Connecticut River." Under this appropriation a survey was made by Capt. W. H. Swift, U. S. Engineer Corps. In his report on this survey, dated January 31, 1837, and printed in House Ex. Doc. No. 252, Twenty-fifth Congress, Capt. Swift submitted a project for deepening the west channel over Saybrook Bar, dredging a cut 500 feet wide and 12 feet deep at mean low water, at an estimated cost of $54,380.50. The estimated cost per cubic yard for dredging and dumping was 25 cents. The available depth over the bar before dredging was 7 feet at mean low water. Capt. Swift's project was approved, and work was begun in May, 1838, under a contract with Randall, Haskell & Holmes, at the rate of 62½ cents per cubic yard, measured in scows. Dredging was continued until the fall of 1840, when the appropriation was exhausted. Twenty-six thousand nine hundred and eighty-four cubic yards of sand and stones had been removed, making a channel 1,500 feet long, 50 feet wide, and from 11 to 12 feet deep. This channel was nearly destroyed by storms and freshets in the following winter and spring. March 1, 1843, $3.471.57 was appropriated to pay a balance due to the contractors.

No further work was done upon the river until 1867.

By act of Congress approved March 2, 1867, a survey of the river was ordered, which was made in the following season, and which embraced the principal bars and obstructions between Hartford and Long Island Sound. With the report on this survey, dated January 11, 1868, and printed on p. 754 *et seq.*, of the Annual Report of the Chief of Engineers for 1868, was presented a project for improving this part of the river. It proposed dredging at Hartford, Clay Banks, Pratts Ferry, Glastonbury, and Pistol Point, to make channels 8 feet deep at low water and 100 feet wide; dredging at Saybrook Bar to make a channel 8½ feet deep and 200 feet wide; piling for shore protection at Hartford and Wethersfield, and the removal of Chester Rock, at a total estimated cost of $70,000. An estimate of $10,000 for annual maintenance was submitted. All the dredging done up to 1880 was in accordance with this project, extended to make 9 to 9½ feet depth instead of 8 feet, and also to include Press Barn, Dividend, and Mouse Island bars. The piling at Hartford was built in 1871, and the removal of Chester Rock was begun in the same year, but abandoned by the contractor soon after beginning.

January 22, 1873, a project for building three jetties at Saybrook and for dredging was approved by the Secretary of War. The jetties were to be of a double row of piles, 20 feet apart, filled with stone to a height of 8 feet above low water. The dredging was to be 9 feet deep and 400 feet wide.

The estimated cost was:

Dredging	$17,850
Jetties	318,760
Total	336,610

Before work on the jetties was begun the plan of construction was modified to one for building them of riprap stone, triangular cross-sections rising to a level of highest water; i. e., about 5 feet above mean low water, this plan being much more economical than the previous one.

The jetties were begun in 1875 and two of them were completed in 1881. The third has not been built and may not be needed. The west jetty has since been extended, and both have been repaired and strengthened.

The river and harbor acts of 1876 and 1882 provided that $2,000 and $5,000 from the Connecticut River appropriation should be applied to improving Salmon River, a small tributary on the east side of the Connecticut River, about 32 miles below Hartford. These sums were expended in making a channel 7 feet deep to the village of Moodus.

In 1880 a project was adopted for permanent works of improvement at six of the worst bars. (See Annual Report of the Chief of Engineers for 1880, part 1, p. 396 *et seq.*) This project provided for riprap wing dams, mattresses, shore protection, and rectification of the banks at the following places, viz,

Locality.	Amount.	Locality.	Amount.
Hartford Bar	$33,464	Glastonbury Bar	$114,922
Clay Banks Bar	69,116	Dividend Bar	7,110
Pratts Ferry or Nanbuc Bar	64,735		
Press Barn Bar	41,140	Total	330,487

with dredging to make and maintain a permanent channel. The project did not provide for extension and repair of the Saybrook jetties, nor did the estimates include any amount for annual dredging to maintain channels, nor for dredging between the jetties at Saybrook, nor for any improvement whatever below Middletown, where considerable dredging has been required. All of these have consumed a large part of the appropriations made since.

Under this project, extended to include other necessary dredging up to the fall of 1887, a training wall of riprap 3,689 feet long had been built at Hartford Bar (instead of the proposed wing dam), and a riprap wing dam 5,300 feet long had been built at Glastonbury Bar, both to a height of 3 feet above low water. Part of the Hartford training wall was subsequently built to 4 feet above low water; the west jetty at Saybrook had been extended to the 16-foot curve, the east jetty to the 12-foot curve, and a channel 130 feet wide and 12 feet deep had been dredged between them, besides maintaining the required depths in this part of the river by annual dredging, at a cost of from $5,000 to $10,000 each year.

In 1887 it had become evident that the proposed plan of permanent improvement would not materially reduce the amount of dredging annually required, and that no effectual substitute could be recommended which would not be very expensive; and in December, 1887, a new project was adopted, under which future operations were to be confined to completing the jetties at the mouth of the river to a height of 5 feet above high water, with a top width of 6 feet, widening the channel between the two jetties to 400 feet, with a depth of 12 feet at mean low water, and annual dredging to maintain the channel from Hartford to Long Island Sound, at an estimated cost as follows:

For completing jetties	$60,000
For dredging between jetties	20,000
Total	80,000
For average annual maintenance of channel from Hartford to Long Island Sound	10,000

The reasons for this change of project are fully given in a letter printed in the Annual Report of the Chief of Engineers for 1888, Part I, pp. 536–538.

In 1889 a modification of this project was adopted which provides for raising the dike at Hartford to a height of 15 feet above low water, at an estimated cost of $50,000, making the total estimate for completion at that time $130,000. The reasons for this modification are given in detail in letters to the Chief of Engineers of October 14 and October 24, 1889, printed in the Annual Report of the Chief of Engineers for 1890, part 1, pp. 614, 615.

Since the modification of the project for dredging, approved by the Chief of Engineers December 22, 1887, 297,313 cubic yards of material have been dredged up to July 1, 1893, from the several bars of the river, all in pursuance of that part of the project relating to annual maintenance of channel from Hartford to Long Island Sound. The amount expended on this work during this time was about $37,000.

Up to July 1, 1893, nothing had been done toward raising the dike at Hartford or toward dredging or enlarging jetties at Saybrook, the available funds at no time having been in excess of what was required for annual maintenance of channels.

Sketches of the Connecticut River from Hartford to Rocky Hill and of Saybrook Bar at the river's mouth were printed in the Annual Report of the Chief of Engineers for 1885.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1894.

At the beginning of the fiscal year the work of maintaining the river channels by annual dredging was in progress under an open-market transaction with C. C. Goodrich, at the rate of 12 cents per cubic yard, approved by the Chief of Engineers, July 18, 1892. Work was continued until September 15, 1893, when it was suspended for the winter; dredging was resumed May 17, 1894, after the spring freshets had subsided, and is still in progress. The total amount dredged during the fiscal year ending June 30, 1894, is 68,147 cubic yards, divided among the several bars as follows:

Locality.	Date.	Cubic yards.
Press Barn Bar	July 1-8, 1893	4,901
Hartford Bar	July 10-12, 1893	2,641
Clay Banks Bar	July 13-20, 1893	6,151
Hartford Bar	July 21-25, 1893	3,093
Glastonbury Bar	July 26-Aug. 1, 1893	4,275
Press Barn Bar	Aug. 2-5, 1893	3,579
Pistol Point Bar	Aug. 7-11, 1893	3,434
Dividend Bar	Aug. 11-12, 1893	472
Glastonbury Bar	Aug. 12-15, 1893	1,301
Dividend Bar	Aug. 16-22, 1893	5,108
Mouse Island Bar	Aug. 23-Sept. 9, 1893	8,442
Calves Island Bar	Sept. 12-16, 1893	972
Glastonbury Bar	May 17-25, 1894	3,990
Clay Banks Bar	May 26-29, 1894	2,145
Hartford Bar	May 31-June 23, 1894	13,128
Dividend Bar	June 25-27, 1894	2,099
Glastonbury Bar (in progress)	June 28-30, 1894	2,326

The above dredging was done to a depth of 9 feet at extreme low water (about 9½ feet below mean low water) and the channels were generally made 50 to 75 feet wide, only sufficient for the immediate needs of navigation.

PRESENT CONDITION OF IMPROVEMENT.

The Hartford Dike and Saybrook jetties are in good condition, though not yet completed.

The freshets of last spring were of less height and of shorter duration than usual, and the several bars in the first 20 miles below Hartford were found in better condition than is generally the case upon subsidence of the freshets. The required depth has been made upon

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The Connecticut River is in the collection district of Hartford. By course of river the distance from Holyoke, Mass., to Hartford, Conn., is about 34 miles, and from Hartford to Long Island Sound about 50 miles.

There is a light-house on Saybrook Point, on the west shore of the river, at its mouth, and another at the end of the west jetty, besides which there are three small beacon lights in the lower part of the river, which are maintained by the United States.

Fort Trumbull, New London Harbor, Conn., about 16 miles east of Saybrook Point, is the nearest work of defense.

Money statement.

July 1, 1893, balance unexpended		$16,740.03
June 30, 1894, amount expended during fiscal year		8,933.27
July 1, 1894, balance unexpended		7,806.76
July 1, 1894, outstanding liabilities	$2,987.56	
July 1, 1894, amount covered by uncompleted contracts	3,157.44	
		6,145.00
July 1, 1894, balance available		1,661.76
Amount (estimated) required for completion of existing project		130,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896		90,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 of sundry civil act of March 3, 1893.		

COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1893.

Arrivals and departures of vessels.

[Draft, 7 to 12 feet; tonnage, 100 to 1,000 tons.]

Kind of vessels.	Number of round trips.
Steamers	400
Sailing vessels	200
Barges	600
Total	1,200

Aggregate tonnage of all trips not ascertained.

Freight received and shipped by water.

Chief articles.	Tons.	Estimated value.
Coal	300,000	$1,120,000
Stone	100,000	500,000
Miscellaneous (not otherwise included)	250,000	45,000,000
Total	650,000	46,620,000

No new lines of transportation have been established since July 1, 1893.

During 1893 three barges were built and two barges and one tugboat repaired in the river.

The depression in business has been such as to stop building and ruin the stone business and to greatly injure coal work and all manufacturing enterprises. We do not own all barges, steamers, and tugs, but so large a proportion that we can guarantee the above to be a close and reliable estimate.

C. C. GOODRICH,
General Manager,
Hartford and New York Transportation Company.

D 4.

IMPROVEMENT OF HARBOR OF REFUGE AT DUCK ISLAND HARBOR, CONNECTICUT.

Duck Island Harbor is a bay on the north shore of Long Island Sound, between headlands known as Menunketesuck and Kelseys points, respectively on the east and west sides of the harbor. It is about 7 miles west of the mouth of the Connecticut River, and midway between the harbors of New Haven and New London. In this distance of 46 miles there is no secure harbor of sufficient size and depth to shelter any considerable part of the general commerce of the sound. Duck Island Harbor has a large anchorage area, with depths of 16 feet or more at low tide and with good holding bottom. It is sheltered from the north by the mainland, partly sheltered from the east by Menunketesuck Point, and slightly sheltered from the south by Duck Island, an island about 900 feet long (north and south) by 300 feet wide, situated in the mouth of the harbor, rather more than half a mile west-southwest from Menunketesuck Point.

PROJECT FOR IMPROVEMENT.

Under act of Congress of August 2, 1882, a preliminary examination of this harbor was made by Col. J. W. Barlow, Corps of Engineers, the report on which was printed in the Annual Report of the Chief of Engineers for 1884, Part I, p. 684, and in Senate Ex. Doc. No. 50, Forty-eighth Congress, first session. This report outlined two plans for improving the security of the harbor, and suggested that the adoption of a project be deferred for further consideration.

The act of Congress approved August 5, 1886, provided for a "resurvey of Duck Island Harbor on Long Island Sound, including plans, specifications, and estimates of cost for making the same a harbor of refuge." A preliminary examination, together with the recent Coast Survey charts, afforded all the information necessary without a detailed survey. In the report of this examination, dated November 12, 1886, and printed (with map) in the Annual Report of the Chief of Engineers for 1887, part 1, p. 641, the required plans, etc., were presented. They contemplated the construction of 3 riprap breakwaters, one extending westerly from Duck Island, one northeasterly from the island toward Menunketesuck Point, and the third southwesterly from Menunketesuck Point. These would shelter an area of about 115 acres, with 16 feet depth or more at low tide in case of southeast storms, with a larger area for storms from any other quarter. The harbor would have a broad western entrance with 17 feet depth and an eastern entrance between the breakwaters over 25 feet deep and about 750 feet wide. The breakwaters proposed were to be of riprap, 10 feet wide on top, which was to be 10 feet above low-water level (about 6 feet above high water), with inside slopes of 1 upon 1, and outside slopes of 2 upon 3.

The estimated cost of riprap stone was as follows:

Breakwater, westerly from Duck Island, 3,000 feet long ....tons..	181,000
Breakwater, northeasterly from Duck Island, 1,750 feet long ....do...	79,000
Breakwater, southwesterly from Menunketesuck Point, 1,130 feet long, tons	41,000
Total, 301,000 tons of stone, at $1.40 per ton	$421,400
Contingencies, 10 per cent	42,140
	463,540

The beginning of work under this project was approved by the Secretary of War, September 27, 1890, after the first appropriation for the harbor had been made, and up to July 1, 1893, 31,549 tons of riprap had been delivered and placed in the breakwater extending westerly from Duck Island, building 1,240 linear feet of work to a height of about 7½ feet above mean low water, with top width of 5 feet. The reduced cross section was adopted as a temporary measure to secure a larger sheltered area at once. The work will require enlarging to make it permanent.

A map showing location and other details of this work was printed in the Annual Report of the Chief of Engineers for 1887, p. 643.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1894.

At the beginning of the year extension of the west breakwater was in progress under a contract with S. & E. S. Belden, for delivering and placing about 34,000 tons of riprap at the rate of $0.89 per ton. Work was continued until November 21, 1893, when the contract was completed. During the fiscal year 25,925 tons of riprap were placed in the breakwater extending it 420 linear feet, building it to a height of about 8 feet above mean low water, with 5 feet top width, and slopes of 1 upon 1.

The total amount of stone delivered under this contract was 34,012 tons, and the total length of breakwater built was 714 feet.

The entire length of the breakwater is 1,660 feet; it contains 57,474 tons of riprap.

A small light is maintained at the outer end of the breakwater.

PRESENT CONDITION OF IMPROVEMENT.

The present length of the breakwater extending westerly from Duck Island is 1,660 feet, being rather more than half its projected length. The first 1,000 feet is from 4 to 5 feet above mean low water, having settled from its original height of 7½ feet; the last 660 feet is now about 8 feet above mean low water.

No work has been done on either of the other projected breakwaters.

PROPOSED OPERATIONS.

Future appropriations will be applied to extending and enlarging the westerly breakwater, and to building the other breakwaters, as provided in the approved project for this work.

Appropriations for harbor of refuge at Duck Island Harbor, Connecticut, have been made as follows:

Application.	Date.	Amount.
Westerly breakwater (916 feet)	Sept. 19, 1890	$25,000
Westerly breakwater (714 feet)	July 13, 1892	35,000
Total		60,000

Duck Island Harbor is in the collection district of Hartford.

The nearest light-house is at Saybrook Point, at the mouth of the Connecticut River, about 8 miles eastward. There is a light vessel on Long Sand Shoal, about 5 miles to the southeast.

Fort Trumbull, New London Harbor, 21 miles east, is the nearest work of defense.

Money statement.

July 1, 1893, balance unexpended	$32,865.18
June 30, 1894, amount expended during fiscal year	31,224.50
July 1, 1894, balance unexpended	1,640.68
July 1, 1894, outstanding liabilities	22.00
July 1, 1894, balance available	1,618.68
Amount (estimated) required for completion of existing project	403,540.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	100,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

Abstract of contract for improving harbor of refuge at Duck Island Harbor, Connecticut, in force during the fiscal year ending June 30, 1894.

Name and address of contractors.	Date of contract.	Subject of contract.	Price of riprap per ton delivered and placed.	Remarks.
S. & E. S. Belden, Hartford, Conn.	Oct. 13, 1892	Delivery of riprap and construction of breakwater.	$0.89	Contract completed Nov. 21, 1893; total number of tons delivered, 34,012.

COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1893.

Commercial statistics have been asked for, but up to date of this report have not been received.

D 5.

IMPROVEMENT OF CLINTON HARBOR, CONNECTICUT.

Clinton Harbor is on the north shore of Long Island Sound, about 10 miles west of the mouth of the Connecticut River. It consists of an open, shallow bay, and of the mouth of the Hammonasset River, a small stream which flows easterly in front of the town wharves, and empties into the bay. For three-quarters of a mile above its mouth the river is separated from the bay by a narrow strip of sand and marsh. About 1840 a breach was made through this strip half a mile above the mouth of the river, which diverted a considerable part of the tidal flow, and since then two bars have formed, one just inside the river's mouth with 4.5 feet depth of water, and one out in the bay shortly before reaching the deep water of the sound, with a depth of 4 feet. It is said that formerly there were depths of from 8 to 12 feet on both these bars, and that shoaling occurred soon after the breach was made.

PROJECT FOR IMPROVEMENT.

By act approved March 3, 1881, Congress authorized a survey of the harbor, which was made the same year. In his report on the survey, dated January 17, 1882, and printed in the Annual Report of the Chief of Engineers for 1882, Part I, p. 630, Colonel Barlow, Corps of Engineers, submitted a project for restoring the original condition of the channel by closing the breach and by subsequently (should the increased tidal current not produce the deepening desired) dredging through the shoals to make a channel 100 feet wide and 6 feet deep at mean low water. The cost of a dike to close the breach was estimated at $3,000, and the cost of the whole project, including the dredging, at $10,000. This project was adopted in 1882, after the first appropriation for the improvement had been made.

Up to July 1, 1893, the dike had been built and repaired; the project had been modified to provide for a channel width of 75 feet instead of 100 feet, and this width, with the required depth, had been obtained. The project was completed in May, 1893.

A sketch of Clinton Harbor was printed in the Annual Report of the Chief of Engineers for 1886, p. 634.

PRESENT CONDITION OF IMPROVEMENT.

The channel now has a depth of 6 feet or more at mean low water with least width of 75 feet up to the wharves.

The dike is in good condition. It will probably need slight repairs within a few years, but none are necessary now.

PROPOSED OPERATIONS.

The dike is completed as designed, and the dredged channel, now 75 feet wide, as provided for in the modified project of 1893, is sufficient for the commercial needs of the harbor; the project is completed. Slight repairs to the dike and deepening of the dredged channel may possibly be required from time to time to maintain the work.

No appropriation is required for the ensuing fiscal year.

Appropriations for improving Clinton Harbor, Connecticut, have been made as follows:

Application.	Date.	Amount.
Construction of dike	Aug. 2, 1882	$3,000
Repairs of dike and dredging	Sept. 19, 1890	3,500
Dredging	July 13, 1892	2,000
Total		8,500

Clinton Harbor is in the collection district of Hartford. The nearest light-house is on Faulkner Island, 8 miles southwest. Fort Hale, New Haven Harbor, 22 miles west, is the nearest work of defense.

Money statement.

July 1, 1893, balance unexpended	$243.78
June 30, 1894, amount expended during fiscal year	243.78

COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1893.

Arrivals and departures of vessels.

[Draft, 4½ to 8 feet; tonnage, 40 to 150 tons.]

Kind of vessels.	Number of vessels.	Number of round trips.
Steamers	5	Frequent.
Sailing vessels	35	35
Barges	3	3

Aggregate tonnage of all trips not ascertained.

Freight received and shipped by water.

Chief articles.	Tons.	Estimated value.
Receipts:		
Coal, oysters, fertilizer	2,000	$15,750
Shipments:		
Wood, railroad ties, ship timber	3,000	10,000
Total	5,000	25,750

No new lines of transportation have been established since July 1, 1893.

The above figures show an increase in tonnage of freight over those reported for last year of 345 tons.

D 6.

IMPROVEMENT OF NEW HAVEN HARBOR, CONNECTICUT.

New Haven Harbor is a bay on the north shore of Long Island Sound, extending about 4 miles inland, and from 1 to 2 miles wide. The Mill and Quinnipiac rivers empty into the head of the harbor; they are streams of no commercial importance, except for tidal navigation at or near their mouths.

The harbor channel is from 400 feet to a mile wide, with mud and sand flats on either side. When the Government began work in this harbor in 1867 the available low-water depth from the city wharves to Cranes Bar, about one-third way down the harbor, was 9 feet; thence to Fort Hale, which is about half way down, it was 16 feet or over. A short distance below Fort Hale was a bar of very soft mud, extending across the harbor, with 13 feet available depth at mean low water.

The entrance to the harbor was partially obstructed by several sunken rocks.

PROJECTS FOR IMPROVEMENT.

Several plans for removal of certain of the rocks at the harbor entrance have been proposed and undertaken, but not completed. The removal of the harbor light-house to Southwest Ledge and the completion of the proposed system of breakwaters will obviate the necessity of further work upon these rocks.

The work of deepening the channel in this harbor has, for the most part, been done in accordance with plans presented in annual or special reports to the Chief of Engineers, the projects being adopted under subsequent appropriations and not based upon examinations or surveys ordered by Congress.

In a letter dated January 20, 1871, printed as House Ex. Doc., No. 95, Forty-first Congress, third session, and also on p. 771 of the Annual Report of the Chief of Engineers for 1871, General Warren, U. S. Engineers, states that "the business of New Haven requires that there should be a channel dredged 200 feet wide and to a depth of 14 feet at mean low water up to the wharves," and that this is "in many respects more important to New Haven than the removal of the rocks at the entrance to the harbor." It was estimated to cost $64,815.

March 3, 1871, $40,000 was appropriated for this harbor, and it was expended in the same year in making a channel 13 feet deep, 200 feet wide up to Long Wharf, 350 feet wide at the bend at Long Wharf, and 100 feet wide from there to the steamboat wl

In a letter of December 23, 1871, printed in House Ex. Doc., No. 137, Forty-second Congress, first session, Gen. Warren submitted an estimate of $26,250 for dredging 16 feet deep and 200 feet wide across Fort Hale Bar, adding that there was some doubt as to the permanence of such a channel. June 10, 1872, $15,000 was appropriated for the removal of rocks and $20,000 for harbor improvement. The former amount was expended upon Luddington Rock; the latter with part of an appropriation of $25,000, made March 3, 1873, was expended in dredging on Fort Hale Bar, and at the close of the season of 1873 the channel had been made 16 feet deep and 200 feet wide as proposed. It soon filled to nearly its former condition. The 13-foot channel above Long Wharf was widened to 110 feet in the same year.

In the Annual Report for 1873, General Warren says:

> It is thought that no improvement here, beyond what can be accomplished with the funds now available, is called for on the part of the United States, and no further appropriation is asked for.

No appropriation for this harbor was made in 1874, and none was recommended in the Annual Report of that year.

January 21, 1875, the House of Representatives, by resolution, asked "for a report from surveys already made in regard to the expediency of widening and deepening the main channel of New Haven Harbor, Connecticut, to a depth not exceeding 20 feet, and also the expediency and estimate of cost of a breakwater." In a report dated January 27, 1875, Col. Barlow, U. S. Engineers, then in charge, submitted the following estimates in reply to that part of the resolution relating to the channel (see Annual Report of the Chief of Engineers for 1875, Part II, p. 250):

For channel 400 feet wide and 20 feet deep	$416,490
For channel 400 feet wide and 18 feet deep	276,990
For channel 300 feet wide and 20 feet deep	329,925
For channel 300 feet wide and 18 feet deep	208,890

Also, February 8, 1875, in reply to request from the Chief of Engineers, he estimated $10,000 as the cost of widening to 200 feet the 13-foot channel above Long Wharf already 110 feet wide.

In submitting these reports the Chief of Engineers recommended the latter work "as being of immediate importance, and whatever action may be taken upon the project of making a 20-foot channel this at least should be done." In a subsequent report on the same matter, February 9, 1875, Colonel Barlow presented an estimate of $35,000 for widening the channel above Long Wharf to 400 feet. This was transmitted to the House of Representatives by the Secretary of War, February 13, 1875, with favorable indorsement of the Chief of Engineers. The latter plan was carried out under the appropriation of $10,000 made March 3, 1875, with a balance of about $6,000 from previous appropriations, and the 13-foot channel was made 415 feet wide above Long Wharf, the price of work being much lower than had been estimated.

Nothing was appropriated for this harbor in 1876 and 1877.

In the Annual Report for 1877 Colonel Barlow refers to the estimates submitted in his letter of January 27, 1875, and recommends that the channel below Long Wharf be made 400 feet wide and 16 feet deep, its then dimensions (200 feet wide and 13 feet deep) not affording "sufficient space for convenient navigation." The estimated cost was $40,000.

In 1878, under the appropriation of $25,000 made June 14, 1878, the channel was dredged to the length and depth proposed, with width of 300 feet.

In a letter of February 4, 1879, transmitting map of harbor examination made in December, 1878 (letter printed in the Annual Report of the Chief of Engineers for 1879, Part I, p. 336), Colonel Barlow recommends deepening the channel above Long Wharf and widening the channel below to secure 400 feet width, with 16 feet depth, from the steamboat wharf down to Fort Hale; also dredging a channel 500 feet wide and 16 feet deep through Fort Hale Bar. The work above Fort Hale was estimated to cost, $65,000; that below, $35,000. The proposed depth and slightly greater width above Fort Hale was obtained by October, 1881, under three successive appropriations of $15,000 each, made in 1879, 1880, and 1881. Nothing had been done on Fort Hale Bar.

In the Annual Report for 1879 a dike at Sandy Point (opposite Fort Hale) was suggested as a means of increasing the depth on Fort Hale Bar, but on account of its expensiveness was not recommended to be undertaken until dredging had been tried again.

In the Annual Report for 1880 (Part I, p. 445), Colonel Barlow renews his recommendation for dredging a channel through Fort Hale Bar 500 feet wide and 16 feet deep.

In the Annual Report for 1881 (Part I, p. 592), after current observations and borings had been made, a dike from Sandy Point is recommended, the length to be determined experimentally as construction progresses, but to be at least 4,400 feet, which length was estimated to cost $60,000.

Under appropriation of $30,000, made August 2, 1882, a plan for this dike was submitted and referred to The Board of Engineers, by whom it was slightly modified and approved October 2, 1882.

The project as approved consisted of a dike connected with Sandy Point by a shore arm about 2,160 feet long and extending southward as a channel arm about 3,200 feet, the channel arm and part of the shore arm to be built of creosoted piling in double rows, filled in with stone. In 1883 the location of the shore arm was modified upon the request of oyster-growers in the vicinity, and in 1886 the method of construction was changed to use riprap instead of creosoted piling, the latter being found more expensive both to construct and to keep in repair.

The appropriations of 1882, 1886, and nearly all of 1888 were expended upon the dike, building the shore arm and more than half of the channel arm. The appropriation of 1884 was expended in dredging under a special project for widening the channel above Long Wharf with depths of 8 to 12 feet, and for removing part of the old piers and abutments at Tomlinson's Bridge, which bridge was at that time being rebuilt.

The present project for making a 16-foot channel across the Fort Hale Bar includes the completion of the dike and dredging a channel 400 feet wide and 16 feet deep through the bar. Revised estimates for completion, made in 1887 (see Annual Report of the Chief of Engineers for 1887, Part I, pp. 599 and 600), placed the cost of completion at that time at $46,000 for the dike and $47,000 for the channel; total, $93,000. This is to be reduced by $45,000, since appropriated, making the present estimate for completion $48,000.

Up to July 1, 1893, the shore arm and 2,089 linear feet of the channel arm of the dike had been built. No dredging had been done on Fort Hale Bar since 1873, and the available depth there was about 13 feet at mean low water; above Fort Hale Bar the channel had been made 16 feet deep at mean low water and from 400 to 700 feet wide.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1894.

Nothing was done.

PRESENT CONDITION OF IMPROVEMENT.

The available depth over Fort Hale Bar is about 13 feet at mean low water. Above the bar there is a 16-foot channel up to Tomlinson's bridge, at the head of the harbor, with from 400 to 700 feet width.

Of the Sandy Point Dike the shore arm, 2,140 feet long, and 2,089 feet of the channel arm (including an ice breaker 20 feet long) have been built; 1,294 feet of the inner end of the shore arm are of riprap; the outer part of the shore arm, 846 feet long, and 254 feet of the north end of the channel arm, are built of two rows of creosoted piling, 8 feet apart from out to out, and filled in with stone; 1,815 feet of the channel arm south of the pile work are built of riprap, of which the north 273 feet are on a log foundation; the ice breaker at the north end of the channel arm is also of heavy riprap on log foundation. Parts of the dike have settled from 1 to 2 feet.

PROPOSED OPERATIONS.

Future appropriations will be applied to dredging the channel or to extending the dike, or to both. The estimated cost of completing these works is $48,000, to which should be added an estimate of $5,000, annually required for maintaining the channels and for repairs of dike.

Appropriations for the improvement of New Haven Harbor have been made as follows:

Application.	Date.	Amount.
Removal of Middle Rock, not expended until 1867	Aug. 30, 1852	$6,000
Removal of rocks	July 11, 1870	15,000
Dredging (13 feet) above Fort Hale	Mar. 3, 1871	40,000
Dredging (16 feet) Fort Hale Bar and removal of rocks	June 10, 1872	35,000
Dredging (16 feet) Fort Hale Bar	Mar. 3, 1873	25,000
Dredging (13 feet) above Long Wharf	Mar. 3, 1875	10,000
Dredging (16 feet) Long Wharf to Fort Hale	June 18, 1878	25,000
Dredging (16 feet) above Long Wharf	Mar. 3, 1879	15,000
Do	June 14, 1880	15,000
Dredging (16 feet) Long Wharf to Fort Hale	Mar. 3, 1881	15,000
Sandy Point Dike	Aug. 2, 1882	30,000
Dredging (18, 12, and 8 feet) above Long Wharf	July 5, 1884	10,000
Sandy Point Dike	Aug. 5, 1886	20,000
Do	Aug. 11, 1888	15,000
Dredging	Sept. 19, 1890	15,000
Do	July 13, 1892	15,000
Total		306,000

New Haven, the port of entry for the collection district of New Haven, is situated at the head of New Haven Harbor, about 3½ miles from Long Island Sound.

There is a light-house on Southwest Ledge, at the mouth of the harbor.

Fort Hale, 2 miles below the city, commands the channel.

Money statement.

July 1, 1893, balance unexpended	$270.58
June 30, 1894, amount expended during fiscal year	91.47
July 1, 1894, balance unexpended	179.11
Amount (estimated) required for completion of existing project	48,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	48 000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

COMMERCIAL STATISTICS FOR CALENDAR YEAR 1893.

Value of imports	$339,979.00
Value of exports	$2,201,000.00
Revenue receipts	$103,938.50
Foreign vessels entered, 122; cleared, 96	218
Domestic vessels entered, 692; cleared, 671	1,363

Tonnage of vessels owned at this port.

	Tons.
Steamers	10,341
Sailing vessels	29,369
Barges	18,305
Total	58,015

Arrival and departure of vessels.

[Draft, 6 to 20 feet; tonnage, 100 to 2,500 tons.]

Kind of vessels.	Number.	Number of round trips.	Aggregate tonnage of all trips.
Steamers of all kinds	26,250	13,125	3,450,000
Sailing vessels	17,980	8,990	4,495,000
Barges in tow, scows, etc	15,150	7,575	1,515,000
Total	59,380	29,690	9,460,000

Coastwise.

Articles.	Tons.	Estimated value.
Coal received and shipped	850,000	$3,400,000
Iron received	140,000	4,200,000
Lumber received, 90,000,000 feet	140,000	2,750,000
Oysters received and shipped	80,000	750,000
Miscellaneous merchandise:		
Shipped	995,000	109,450,000
Received	900,000	122,000,000
Total	3,105.000	242,550,000

The above figures show a decrease in tonnage of freight since last year's report of 38,000 tons, stated to be due to the prevailing business depression of 1893.

No new lines of transportation have been established since July 1, 1893.

D 7.

CONSTRUCTION OF BREAKWATERS AT NEW HAVEN, CONNECTICUT.

New Haven Harbor is the only natural harbor of any considerable area and depth in Long Island Sound between New London Harbor, 45 miles east, and Huntington Bay, 32 miles southwest. At this point Long Island Sound is at its widest, and the broad, open mouth of the harbor left the anchorage grounds exposed to storms from a southerly quarter, so that vessels driven in by stress of weather were frequently obliged to cross Fort Hale Bar, going from 2 to 4 miles up the harbor, and to anchor in the dredged channel, in order to reach secure shelter.

PROJECT.

December 15, 1874, the harbor commissioners of New Haven addressed a memorial to the members of Congress from Connecticut asking that measures be taken "to procure appropriations by Congress for deepening the main ship channel of the harbor to 20 feet and for constructing a breakwater from the light-house (then on Five-Mile Point) to Southwest Ledge."

The memorial, printed in House Ex. Doc. No. 162, Forty-third Congress, second session, states that the breakwater contemplated would add greatly to the value of the harbor as a harbor of refuge.

January 21, 1875, a resolution was passed by the House of Representatives asking "for a report from surveys already made in regard to the expediency of widening and deepening the main channel of New Haven Harbor, Connecticut, to a depth not exceeding 20 feet, and also the expediency and estimate of expense of a breakwater between the eastern shore of the entrance to said harbor and Southwest Ledge, so called, or such part of said distance as may be found most expedient or necessary for the protection of said harbor." In reply to this resolution a report was made by Col. J. W. Barlow, Corps of Engineers, dated January 27, 1875, printed in House Ex. Doc. above mentioned, and also in the Annual Report of the Chief of Engineers for 1875, Part II, p. 251, suggesting three locations for a breakwater, viz:

1. That indicated in the resolution and terminating at Southwest Ledge.

2. A line running nearly east and west, its middle point resting upon Adams Fall Rock, about one-half mile north of Southwest Ledge.

3. A line 400 yards farther north, running nearly west from Five-Mile Point.

Estimates of cost, ranging from $248,000 to $465,330, were submitted, and with the report were also presented letters and commercial statistics bearing upon the subject.

The question of a westerly breakwater does not appear to have been considered at that time.

This report is referred to by Colonel Barlow in the succeeding Annual Reports for 1876, 1877, and 1878, and in the latter year additional statistics were submitted, but no action was taken until 1879, when an appropriation of $30,000 was made for the "construction of a breakwater at New Haven, Conn."

In August of the same year an examination of part of the mouth of the harbor was made and a map transmitted to the Chief of Engineers with several projects for breakwaters, which were referred to The Board of Engineers for report.

The report of the Board, dated November 24, 1879, and printed in the Annual Report of the Chief of Engineers for 1880, Part I, pp. 449–452, recommended a breakwater from Southwest Ledge to Quixes Ledge, as contemplated in the resolution of the House of Representatives of January 21, 1875, but as the anchorage ground would still be exposed to southwesterly gales the Board stated as its opinion that a breakwater extending northwest from Luddington Rock would be necessary. Their plan provided for 2 riprap breakwaters, 12 feet wide on top, rising 6 feet above high water, with exterior slopes of 1 on 3, and interior slopes of 2 on 3, with estimates as follows:

Estimates for breakwater from Light-house Ledge to Quixes Ledge.

Length of construction .... yards..	1,100
Average height of work .... feet..	32
Average cross section .... yards..	299
Cost per cubic yard	$2
328,900 cubic yards, at $2	$657,800

Estimates for breakwater in vicinity of Luddington Rock.

Length	yards..	1,400
Average height	feet..	28
Cross section	square yards..	233⅓
326,667 cubic yards, at $2		$653,334

This plan locates the easterly breakwater so as to lie between Light-House Ledge (or Southwest Ledge) and Quixes Ledge, and the westerly one to extend in a northwest and southeast direction overlying Luddington Rock. The report of the Board was transmitted to the Secretary of War by the Chief of Engineers with the suggestion that the appropriation ($30,000) be applied toward the construction of the easterly breakwater, and was approved by him January 31, 1880. Before work had been begun the details of cross section were modified, with the approval of the Chief of Engineers, so that the exterior slope should be 1 on 2 and the interior 1 on 1.

The first load of stone was delivered April 22, 1880, beginning the east breakwater at the end resting upon Southwest Ledge. Under subsequent appropriations it was extended northeasterly and completed to and across Quixes Ledge on February 22, 1890.

The river and harbor act of 1888 provided:

> And the Chief of Engineers may, if deemed necessary, relocate the western breakwater, and the Secretary of War is authorized, in his discretion, to expend any portion of said sum in its commencement.

An examination in reference to this matter was made in the fall of 1888, and the results reported to the Chief of Engineers in a letter dated January 26, 1889, and printed in the Annual Report of the Chief of Engineers for 1889, part 1, p. 679. In the annual report for 1889 (see Annual Report of the Chief of Engineers for 1889, Part I, p. 678) was presented a modification of the project adapted to the present and prospective requirements of commerce of Long Island Sound. This modification contemplated the relocation of the westerly breakwater by changing its location about 6,000 feet to the southwestward and the construction of a middle breakwater, commencing at a point 1,000 feet N. 54° E. from Luddington Rock, and extending south 54° W. 5,000 feet, crossing the rock; and also a breakwater about 1,200 feet long, to partly close the space between Quixes Ledge and the east shore.

The cross section of these breakwaters was intended to be the same as the one from Southwest Ledge to Quixes Ledge, viz, 12 feet wide on top, the top to be 6 feet above mean high water, with outer slope of 1 upon 2, and inner slope of 1 upon 1. It was estimated that this relocation of the western breakwater, including the intermediate breakwater across Luddington Rock, would increase the cost of completion ($941,135 in 1889) by about $750,000, and the construction of the breakwater at the east shore would add about $90,000 more.

By act of Congress approved September 19, 1890, $120,000 was appropriated for "constructing breakwater at New Haven, Conn., in accordance with the plans submitted by the Chief of Engineers in Report for 1889, p. 678."

The estimated cost of this project from the beginning is therefore ($1,311,134 + $750,000 + $90,000) $2,151,134, of which, up to July 1, 1893, $610,000 have been appropriated, and the estimated cost of completion of the project is $1,541,134.

Up to July 1, 1893, the breakwater easterly from Southwest Ledge had been completed, and the westerly breakwater across Luddington Rock had been made 2,911 feet long, with reduced cross sections; work was in progress.

A sketch of New Haven Harbor, showing the locations of breakwaters proposed under the existing projects was printed in the Annual Report of the Chief of Engineers for 1889, p. 678.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1894.

At the beginning of the year, extension and enlargement of the breakwater southwesterly from Luddington Rock was in progress under a contract with John Beattie, dated September 13, 1892. Work was continued until December 9, 1893, when the contract was completed. During the fiscal year 48,849 tons of riprap granite were delivered and placed in the breakwater, which was extended 255 linear feet and enlarged along about one-half its entire length.

Under the contract 110,028 tons of riprap were delivered, of which 68,613 tons were used in extending the breakwater 950 feet southwestwardly, and 41,415 tons were used in enlarging work built under the previous contract.

Since the completion of the contract lights have been maintained on the breakwater by the Engineer Department.

PRESENT CONDITION OF WORK.

The east breakwater was completed February 22, 1890; it is 3,450 feet long, extending from the foundation of the light-house on Southwest Ledge northwesterly to and across Quixes Ledge, terminating in a depth of 16 feet of water at the edge of the east entrance channel. It contains 293,777 tons of riprap, and the average cost (supervision, etc., included) has been $102.50 per linear foot. The whole work is in good condition.

The breakwater crossing Luddington Rock is now 3,166 feet long, 500 feet of which lies northeast of the crest of the rock and 2,666 feet southwest. It has all been built to cross section of 12 feet top width, the top being 6 feet above mean high water, with side slopes of 1 upon 1. As the work settles slight repairs will be needed; the outer slope will also need building to the projected grade of 1 upon 2.

The southwest end of the breakwater is now in a depth of 22½ feet at mean low water.

The Luddington Rock breakwater contains 220,054 tons of riprap.

PROPOSED OPERATIONS.

Future appropriations will be applied to completing this breakwater and to carrying out the project as adopted.

Appropriations for breakwaters at New Haven have been as follows:

Application.	Date.	Amount.
Easterly breakwater	Mar. 3, 1879	$30,000
Do	June 14, 1880	30,000
Do	Mar. 3, 1881	60,000
Do	Aug. 2, 1882	60,000
Do	July 5, 1884	40,000
Do	Aug. 5, 1886	75,000
Completing easterly breakwater	Aug. 11, 1888	75,000
Middle breakwater	Sept. 19, 1890	120,000
Do	July 13, 1892	120,000
Total		610,000

New Haven, the port of entry for the collection district of New Haven, is situated at the head of New Haven Harbor, about 4 miles north of the breakwaters.

There is a light-house on Southwest Ledge, the west terminus of the east breakwater.

Fort Hale, 2 miles north of the breakwater, commands the harbor channel.

Money statement.

July 1, 1893, balance unexpended	$87,057.18
June 30, 1894, amount expended during fiscal year	84,326.16
July 1, 1894, balance unexpended	2,731.02
July 1, 1894, outstanding liabilities	50.00
July 1, 1894, balance available	2,681.02
Amount (estimated) required for completion of existing project	1,541,134.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	500,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

Abstract of contract for construction of breakwater at New Haven, Conn., in force during the fiscal year ending June 30, 1894.

Name and address of contractor.	Date of contract.	Subject of contract.	Price of riprap per ton.	Remarks.
John Beattie, Leetes Island, Connecticut.	Sept. 13, 1892	Delivering riprap granite and extending and enlarging breakwater; amount required, about 110,000 tons.	$1.09	Contract completed December 9, 1893; amount delivered, 110,028 tons.

COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1893.

Vessels passing New Haven breakwater.

Men-of-war	29
Steamers of all kinds	41,250
Steamships	2,230
Ships, barks, and brigs	1,460
Schooners and sloops	48,190
Barges in tow, scows, etc	34,200
Total	127,359

These records are not complete, as many vessels pass unobserved in night or in thick weather.

The value of this commerce can not be ascertained.

D 8.

IMPROVING MILFORD HARBOR, CONNECTICUT.

This harbor is on the north shore of Long Island Sound, about 9 miles southwest of New Haven, Conn. It consists of a broad, open bay, from the head of which the Wepauwog River, a small tidal stream, extends three-quarters of a mile north to the Milford wharves, and the Indian River, another small inlet, extends northeasterly. The mouth of the latter stream is partly closed by a dam formerly used to create power for a tide mill.

The original depth on the bar just outside the mouth of the river was less than 2 feet at mean low water, and in some places between there and the upper wharves low tide left the channels nearly bare.

The mean rise of tide is 6.2 feet.

PROJECTS FOR IMPROVEMENT.

A survey of breakwater at Milford, Conn., was ordered by Congress in the river and harbor act of 1872. There being no breakwater, a survey of the harbor was made for a breakwater, and in his report, dated December 24, 1872 (printed as part of Ex. Doc. No. 107, Forty-second Congress, third session, and on p. 1041 of the Annual Report of the Chief of Engineers for 1873), General Warren, U. S. Engineers, submitted the following plan of improvement:

1. A riprap breakwater from Welchs Point, on the east side of the mouth of the harbor	$67,000
2. Protecting the bluffs on the east shore from erosion by means of small stone jetties	5,500
3. Dredging 4 feet deep and 100 feet wide across the bar at the mouth of the river	6,250
4. A jetty on the east side of the channel to prevent dredged area from filling, and to confine the action of the tide	5,000
Superintendence	1,250
Total	85,000

In 1874 $5,000 was appropriated for this harbor, and work under the above project was begun, building the small jetties to protect the east shore. Twelve such jetties were built, 100 to 130 feet long, and rising to 9 feet above mean low water. The appropriation of 1875 ($13,000) was applied to the repair of these jetties, to construction of a jetty from the east shore at the mouth of the Indian River (Long Jetty), and to dredging across the bar.

In the Annual Report for 1876 (Part I, p. 2251) Colonel Barlow, U. S. Engineers, recommended that the dredged channel be carried up to Town Wharf, about half a mile further, at an additional estimated cost of $9,000.

This recommendation was renewed in 1877, and was included in the project for expenditure for the appropriation of $10,000 made in 1878. In that and the following year the 4-foot channel across the bar was completed to 100 feet width, as originally projected, and was extended to Town Wharf, with width from 60 to 75 feet, and Long Jetty was repaired; also under same appropriation, in 1879 and 1880, an additional jetty, authorized by Department letter of October 16, 1879, was built on the west side of the channel, extending southward from Burns Point. This appropriation completed the original project, except the breakwater; sufficient money for beginning that had not been appropriated.

June 14, 1880, $5,000 was appropriated, and in accordance with a project for its expenditure, submitted and approved, the 4-foot harbor channel was extended from Town Wharf to the Straw Works Wharf, at the upper end of the harbor, with a width of 40 feet. This was completed before the appropriation was exhausted, and—

> At the earnest solicitations of those most interested in the works of improvement there an experimental channel, 25 feet wide and 8 feet deep, was cut through the

bar at the entrance, lying within and on the west side of the channel already made. This is now of great use to the steam vessels employed in the fish-oil works at that place, and it is claimed that the increase of shipping in the harbor, particularly in the oyster business, for which those waters seem very well adapted, will soon require an 8-foot channel of fully 100 feet width. Such a channel would involve the removal of about 45,000 cubic yards more of material, principally sand and gravel, which at ruling prices would cost, including superintendence and incidental expenses, about $11,000. (Extract from Colonel Barlow's annual report for 1881; see Annual Report of the Chief of Engineers for 1881, Part I, pp. 598 and 599.)

Under the appropriation of $5,000 made August 2, 1882, the project above suggested was adopted, and the 8-foot channel was widened to 65 feet from the bay up to Merwin's Wharf, with 100 feet width around the bend at Burns Point. In 1889 this channel was made fully 100 feet wide, and some needed repairs to Long Jetty were begun.

By act of Congress approved March 3, 1881, a survey for a breakwater and harbor of refuge at Milford Harbor was authorized. The survey was made, and a report, with estimates, was submitted January 20, 1882. This report is printed in the Annual Report of the Chief of Engineers for 1882, part 1, p. 632.

Under date of December 14, 1889, Hon. O. H. Platt, U. S. Senate, wrote the Chief of Engineers, requesting an examination of Milford Harbor, and a report upon dredging the channel to the upper wharves. This report was made December 31, 1889. In compliance with a resolution of the House of Representatives of January 18, 1890, a copy of the report was transmitted to the House, and printed as House Ex. Doc. No. 139, Fifty-first Congress, first session; also in the Annual Report of the Chief of Engineers for 1890, part 1, p. 629.

The act of Congress approved September 19, 1890, appropriated $2,500 for this improvement. This amount was estimated in previous annual reports as required for repairs of the jetties; and with the approval of the Chief of Engineers granite was purchased in open market to be used in widening the base of Long Jetty, at the mouth of the Indian River, the price being $2.50 per gross ton delivered and placed; 840 tons of stone were so delivered, and the entire outer side of the jetty was widened and the most exposed part of the inner side.

The project for this harbor improvement is completed.

Sketches of the harbor showing location of improvements were printed with the Annual Reports of the Chief of Engineers for 1884 (p. 648) and for 1886 (p. 640).

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1894.

During the severe storm of August 24, 1893, Long Jetty suffered severe injury. An examination showed that the principal break was one of about 30 feet long and from 3 to 5 feet deep, near the west end of the jetty, but that in several places a few stones had been washed off from the top of the work, and that, if neglected, further injury would undoubtedly result. There was no appropriation for this harbor, but upon reporting the facts to the Chief of Engineers, with an estimate of $250, as the cost of repairs immediately necessary, that sum was allotted from the appropriation of July 13, 1892, for preliminary examinations, contingencies, etc. With these funds the repairs necessary for preservation of the jetty were made in December 1893; 85 tons of stone were furnished and placed in the jetty at the rate of $2.50 per ton, and 10 tons of stone which had been thrown down by the storm were replaced at $1.25 per ton. The wall was built up to full dimensions where the principal break occurred, and for 200 feet of its length it was repaired and strengthened.

At request of interested parties a plan of harbor lines was ordered to be prepared, and an allotment of $200 was made from the appropriation for "Examination, surveys, and contingencies of rivers and harbors," to defray the expenses of making the necessary survey of shore line as it now exists, and of preparing plans, etc.

The survey has been made, the preliminary plans have been prepared, and the views of interested parties publicly invited, and are now under consideration.

The plan for harbor lines will be submitted with recommendation as to its adoption early in the ensuing year.

PRESENT CONDITION OF IMPROVEMENT.

Long Jetty, as now repaired and enlarged, has dimensions as provided in the project, viz. outer slope 2 upon 3, and inner slope 1 upon 1, except for about 300 feet at the shore end, where the inner slope is steeper. To complete the work sufficiently to make it secure would cost about $1,500; it would probably be more economical and quite as satisfactory to make slight repairs from time to time as they may be required. The other jetties are in fair condition.

The channel dredged 4 feet deep at mean low water from the mouth of the river to the Straw Works Wharf, with width of 60 feet for about two-thirds its length and 40 feet for the remaining third, has shoaled somewhat on the sides.

The channel across the bar at the mouth of the river is 8 feet deep and over 100 feet wide; it is now being widened by private parties under authority granted by the Secretary of War.

PROPOSED OPERATIONS.

The project is completed, and nothing further is contemplated under it, except what is from time to time necessary for the maintenance of the jetties and dredged channels.

No appropriation is needed for the ensuing year.

Appropriations for Milford Harbor, Connecticut, have been made, as follows:

Application.	Date.	Amount.
Survey	June 10, 1872	$1,500
Jetties on east shore	June 23, 1874	5,000
Long Jetty and dredging at mouth of river	Mar. 3, 1875	13,000
Dredging to Town Wharf	June 18, 1878	10,000
Dredging above Town Wharf and (8 feet) below Merwins Wharf on bar	June 14, 1880	5,000
Survey for breakwater	Mar. 3, 1881	100
Dredging 8 feet on bar	Aug. 2, 1882	5,000
Dredging 8 feet on bar and repairing Long Jetty	Aug. 11, 1888	5,000
Repairing jetties	Sept. 19, 1890	2,500
Total		47,100

Milford Harbor is in the collection district of New Haven; it is about 9 miles west from Fort Hale, New Haven Harbor.

The nearest light-house is on Stratford Point, 4 miles to the westward.

COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1893.

[Through courtesy of W. M. Merwin, Milford, Conn.]

Arrivals and departures of vessels.

[Draft, 3 to 10 feet; tonnage, 10 to 200 tons.]

Kind of vessels.	Number of round trips.
Steamers	1,695
Sailing vessels	800
Barges	25
Total	2,520

Aggregate tonnage of all trips not ascertained.

Freight received and shipped by water.

Chief articles.	Tons.	Estimated value.
Receipts:		
Seed oysters, 80,000 bushels	2,400	$56,000
Coal	5,000	25,000
Total receipts	7,400	81,000
Shipments:		
Seed oysters, 80,000 bushels	2,400	56,000
Total shipments	2,400	56,000

No new lines of transportation have been established since July 1, 1893.

The year 1893 was not a fair average year for commerce by water, on account of the disastrous storms preventing the selling of seed oysters, and on account of no barrel oysters having been shipped, as they were too small for market, no oysters having been set in the harbor during 1888 and 1889.

D 9.

IMPROVEMENT OF HOUSATONIC RIVER, CONNECTICUT.

The Housatonic is a long, shallow river running southward through Massachusetts and Connecticut, and emptying into Long Island Sound just east of Stratford Point, about 15 miles southwest from New Haven. At Derby, 13 miles above its mouth, it receives the discharge of the Naugatuck, a small, rapid river. This point, which has been regarded as the head of navigation, is nearly the head of tide water. About a mile above there is a dam across the Housatonic River, furnishing large water power. For at least 5 miles below Derby the water is always fresh.

The original depth on the worst bars in the river (6 in number) was from 3.5 to 4.5 feet at mean low water; there was also a bar across the river's mouth with about 4 feet low-water depth.

PROJECTS FOR IMPROVEMENT.

In pursuance of a resolution of the House of Representatives dated December 20, 1869, authorizing a survey of the Housatonic River below Derby, which resolution was referred by the Secretary of War to the Chief of Engineers for report as to the "necessity for the survey," an examination of the river from Derby to Long Island Sound was made by Col. D. C. Houston, Corps of Engineers, who reported January 8, 1870, and recommended a detailed survey of all that part of the river, at an estimated cost of $5,000. This report was printed in House Ex. Doc. No. 62, Forty-first Congress, second session.

By act of Congress approved July 11, 1870, a survey of Housatonic River below Derby, Conn., was directed, and an allotment of $2,700 was made for a survey "sufficient to determine the prominent obstructions to navigation." In his report on this survey, dated January 23, 1871, and printed in House Ex. Doc. No. 95, Forty-first Congress, third session, and also in the Annual Report of the Chief Engineers for 1871, p. 781, Gen. G. K. Warren, Corps of Engineers, submitted the following estimates for making a channel 7 feet deep at mean low water, to be 200 feet wide over the bar at the mouth of the river and 150 feet wide in the river, the channel at the river's mouth to be protected on the east side by a breakwater from Milford Beach:

Jetty at Sow and Pigs Reef	$4,000
Removing Drews Rock, 357 cubic yards	2,000
Dredging inside the bar at the mouth	18,486
Dredging on the bar at the mouth	12,000
Construction of breakwater at mouth	368,475

The breakwater was to be built of riprap up to 1½ feet above mean low water and of dimension stone above; it was to be 6 feet wide on top, rising to 11 feet above low water, and was to extend to the 6-foot curve, at an estimated length of 4,200 feet.

March 3, 1871, the first appropriation for improvement of the river was made, and work in accordance with the project was begun. In 1872 the project was modified to admit of a jetty connecting Drews Rock with the west bank instead of removal of the rock. This was done on the ground of economy, and the jetty was built in 1872. The result was to form a bar below the jetty, which required such frequent dredging that it was found expedient to remove the rock as originally projected. This was done in 1887-'88.

Dredging on the several bars in the river had been done from time to time before 1885, but no work had been done upon the bar at the mouth. The importance of deepening the entrance to the river, then about 4 feet deep, was not overlooked, but it was believed that a dredged channel would have little or no permanency unless protected by a breakwater, and appropriations had not been made in sufficient amount to warrant beginning breakwater construction upon the estimates submitted in 1871. In 1879 Major Barlow proposed to substitute for the originally designed breakwater a riprap structure, such as had been built in other parts of Long Island Sound, and in order to make the estimated cost as low as possible he proposed to try the effect of such a work built up to low-water level only, and about 6,000 feet long, which he estimated to cost $12,000. In 1882 this estimate was raised to $20,250. In 1885 and 1886 certain oyster-growers who wished to use the material of this bar for oyster-beds offered to dredge a channel without expense to the United States. With approval of the Secretary of War this was done under contract, and in two years 52,888 cubic yards of sand, gravel, and shells were dredged, making an entrance channel 70 feet wide and 9 feet deep. The first severe storm which occurred after the channel was dredged filled it at its outer end and showed practically that dredging there was useless unless the channel could be protected by a sufficient breakwater.

Therefore, in the Annual Report for 1887 (see Annual Report of the Chief of Engineers for 1887, Part I, p. 607), Colonel Houston, U. S. Engineers, then in charge, presented revised estimates for a breakwater, modifying the originally proposed method of construction to one for using riprap only, experience at the harbors of Long Island Sound having shown this construction to be as durable as dimension work and more economical.

At the same time estimates based on recent surveys for dredging necessary to make the channel 7 feet deep, with width 200 feet at the mouth of the river and 100 feet above, were submitted. The latter width was adopted in 1883, because up to that time the originally proposed width of 150 feet had never been obtained.

Following are the estimates for breakwater and for dredging submitted in 1887:

For a breakwater 5,750 feet long, extending from Milford Beach 3,250 feet in a course about south-southeast, thence parallel with and 500 feet from the channel 2,500 feet farther to the 12-foot curve; inside the bend to be built up to 3 feet above mean low water, top width 6 feet, side slopes 1 upon 1; outside the bend to be built up to 6 feet above high water, top width 12 feet, outer slope 1 on 2, and inner slope 1 on 1	$175,000
For dredging at the mouth of the river and at 6 bars in the river, 146,000 cubic yards, at 16 cents, with about 15 per cent added for contingent expenses	27,000
Total	202,000

to which should be added about $4,000 annually required for maintenance of channels.

January 27, 1888, a letter further explaining the reasons for the new estimate for breakwater was submitted to the Chief of Engineers, and was subsequently printed as Senate Ex. Doc. No. 103, Fiftieth Congress, first session, and also in the Annual Report of the Chief of Engineers for 1888, Part I, p. 554.

Construction of the breakwater was begun July, 1889, the shore end being located on Milford Beach, on a tract of land deeded to the United States for that purpose (Annual Report of the Chief of Engineers for 1889, p. 690). In July, 1892, after the breakwater was sufficiently advanced to afford some protection, a channel 7 feet deep was dredged through the outer bar.

At the bend in the river between Stratford and the sound, where the currents had formed two channels in the river, a small riprap dike was begun in 1893 to cut off the westerly one of these channels.

Up to July 1, 1892, the breakwater at the mouth of the river had been built to a length of 4,740 feet, the 3,250 feet nearest the shore end being built to half-tide level, and the outer 1,490 feet to 4 feet above high water, with top width of 5 feet. The available depth on the bars in the river was about 4½ feet, and on the outer bar from 5 to 6 feet, in a crooked channel.

Sketches of the mouth of the Housatonic River were printed in the Annual Reports of the Chief of Engineers for 1886, p. 642, and for 1887, p. 608; and a sketch of the whole length of the river below Derby in the report for 1882.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1894.

At the beginning of the year three contracts for work upon this river were in force.

Under contract with Brown & Fleming, for extending the breakwater, dated October 4, 1892, work had been suspended December 5, 1892; it was resumed August 26, 1893, and the contract was completed December 20, 1893. During the fiscal year 5,482 tons of riprap were placed in the breakwater, extending it 285 feet. The total amount of riprap delivered under this contract was 8,782 tons, and the total length of work built was 453 feet. Slight repairs were also made to part of the breakwater about 500 feet out from the shore.

Under contract with the W. H. Beard Dredging Company, for hire of dredging plant, dated May 26, 1893, work was in progress at the beginning of the fiscal year. It was continued until August 9, 1893, when the contract was completed. During the fiscal year the dredge worked one hundred and eighty-four and one-twelfth hours, removing 15,861 cubic yards of material. The total number of hours' work of the dredging plant under the contract was two hundred and thirty-five and one-twelfth, and the total amount of material removed was 19,796 cubic yards, being an average cost of 22 cents per yard. A channel 75 feet wide and 9 feet deep was dredged through the bar a distance of about 1,600 feet; the depth was made greater than the projected depth, to increase the chances of the channel keeping open.

Under contract with D. V. Howell, for constructing the shore end of the dike at the bend below Stratford, actual construction was begun early in July, 1893, and the contract was completed September 20, 1893. Two thousand and forty-five tons of riprap were placed in the dike, building it out from shore a distance of 555 feet.

PRESENT CONDITION OF IMPROVEMENT.

The breakwater is now 5,025 feet long and contains 42,419 tons of riprap; for 3,250 feet nearest the shore end it is built to about half-tide level; the outer 1,775 feet, are built up to 4 feet above mean high water, with top width of 5 feet.

During the past year the channels over the bars in the river have changed little; their available depth is generally from 4 to 5 feet at low water. The channel on the outer bar is reported as retaining very nearly the full depth of 9 feet, made by dredging in the spring of 1893.

PROPOSED OPERATIONS.

Future appropriations should be applied to making and maintaining the river channel and to completing the breakwater and dike.

The estimated cost of completing this improvement is $112,000, to which should be added about $4,000 annually required for maintenance of dredged channel and for repairs.

Appropriations for the Housatonic River have been made as follows:

Application.	Date.	Amount.
Examination	Mar. 2, 1867	$42
Survey	July 11, 1870	2,700
Sow and Pigs Jetty, dredging	Mar. 3, 1871	15,000
Drew Rock Jetty, dredging	June 10, 1872	15,000
Dredging	Mar. 3, 1873	10,000
Do	June 23, 1874	10,000
Do	Mar. 3, 1875	5,000
Do	June 18, 1878	5,000
Do	June 14, 1880	2,000
Do	Mar. 3, 1881	2,000
Removing Drew Rock and jetty in 1887	Aug. 2, 1882	2,000
Do	July 5, 1884	2,500
Do	Aug. 5, 1886	5,000
Commencing breakwater, dredging	Aug. 11, 1888	35,000
Extending breakwater, dredging	Sept. 19, 1890	35,000
Extending breakwater, dike and dredging	July 13, 1892	20,000
Total		166,242

The Housatonic River is the boundary between the collection districts of New Haven and Fairfield. The nearest work of defense is Fort Hale, New Haven Harbor, about 15 miles east. The nearest light-house is on Stratford Point, at the mouth of the river.

Money statement.

July 1, 1893, balance unexpended	$16,456.19
June 30, 1894, amount expended during fiscal year	15,021.19
July 1, 1894, balance unexpended	1,435.00
Amount (estimated) required for completion of existing project	112,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	100,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

Abstract of contracts for improving Housatonic River, Connecticut, in force during the fiscal year ending June 30, 1894.

Name and address of contractor.	Date of contract.	Subject of contract.	Price.	Remarks.
Brown & Fleming, New York City.	Oct. 4, 1892	Delivery of riprap and construction of breakwater.	$1.12 per ton of riprap.	Contract completed Dec. 20, 1893. Amount delivered, 8,782 tons.
The W. H. Beard Dredging Co., New York City.	May 26, 1893	Hire of dredging plant.	$18.50 per actual working hour of dredge.	Contract completed Aug. 9, 1893. Total number of hours, 235$\frac{1}{5}$.
David V. Howell, New York City.	May 25, 1893	Delivery of riprap and construction of dike.	$1.27 per ton of riprap.	Contract completed Sept. 20, 1893. Amount delivered, 2,045 tons.

Commercial statistics for calendar year 1893.

ABOVE STRATFORD TO THE HEAD OF NAVIGATION.

Vessels arriving and departing.

[Draft, 4 to 8 feet; tonnage, 50 to 450 tons.]

Kind of vessels.	Number of round trips.	Aggregate tonnage of all trips.
Steamers	226	34,000
Sailing vessels	200	21,275
Barges	260	40,500
Total	686	95,775

Freight received and shipped.

Chief articles.	Tons.	Estimated value.
Coal	65,000	$325,000
Iron	12,000	168,000
Miscellaneous (lumber, stone, sand, cement, rubber, copper, etc.)	42,630	1,560,900
Total	119,630	2,053,900

BELOW STRATFORD.

[Through courtesy of Mr. H. J. Lewis, Stratford, Conn.]

Arrivals and departures of vessels.

[Draft, 2 to 7 feet; tonnage, 3 to 100 tons.]

Kind of vessels.	Number of round trips.	Aggregate tonnage of all trips (estimated).
Steamers	1,000	60,000
Sailing vessels	10,620	73,000
Barges	75	22,500
Total	11,695	155,500

Freight received and shipped by water.

Chief articles.	Tons.	Estimated value.
Coal	10,000	$50,000
Oysters	200	20,000
Oyster shells	20,000	40,000
Miscellaneous (not otherwise included)	10,000	200,000
Total	40,200	310,000

The total tonnage of river freight as above reported is 159,830 tons for both parts of the river, being 42,495 tons less than that reported for 1892. The decrease is wholly due to the prevailing business depression.

No new lines of transportation have been established since July 1, 1893.

D 10.

IMPROVEMENT OF BRIDGEPORT HARBOR, CONNECTICUT.

This harbor extends nearly 3 miles inland from the north shore of Long Island Sound, its width of about 1 mile at the mouth decreasing to 200 feet between opposite wharves at its upper end. The channel, even in the widest part of the harbor, is comparatively narrow.

Before the first work by the United States was done at this harbor the depth over the bars at the harbor's mouth was about 5 feet at low water, equivalent to 11.5 at high water, and the low-water depth above the bridges was from 2 to 7 feet.

PROJECTS FOR IMPROVEMENT.

In 1833 a petition of the citizens of Bridgeport was presented to Congress asking an appropriation of $10,000 to improve the harbor. This was granted in 1836, and the agent in charge was instructed by the Engineer Department to dredge a channel 8 feet deep, making it 200 feet wide through the outer bar and 100 feet wide through the inner bar, or so much as the appropriation would admit of. The work was done by contract in 1837. The rate was high (understood to be 72.8 cents per cubic yard), and the funds were exhausted when the channel through the outer bar had been made 60 feet wide.

In 1838, Captain Swift, U. S. Engineers, reported that the channel had been sounded and was found to be 12 feet deep, or 4 feet deeper than when left by the dredger.

Nothing further was done until 1852, when a second appropriation of $10,000 was made.

Captain Dutton, U. S. Engineers, found that the channel on the outer bar was then 6 feet deep and 90 feet wide, and on the inner bar but 5 feet deep, and he submitted a project for dredging through both bars to a depth of 8 feet and a width of 200 feet, at a total estimated cost of $32,000. This project was approved by the Secretary of War February 5, 1853, and with the $10,000 then available channels 8 to 13 feet deep were dredged 100 feet wide through the inner bar and 60 feet wide through the outer bar.

By act of Congress approved June 23, 1866, a survey of the harbor was ordered, which was made in that year. The object of the survey was to ascertain "the present state of the harbor, and the character and extent of the encroachments upon it by the action of the tides," it being feared that Long Beach, on the east side of the harbor's mouth, was making northwestward by reason of sand drifting along the shore in such a way as to contract and ultimately fill up the channel above the inner bar. Col. D. C. Houston, U. S. Engineers, then in charge, in his report on the survey, dated January 12, 1867, stated that it had been proposed to construct a breakwater extending out from Long Beach to arrest the sand; but the danger feared did not seem imminent, and he recommended a series of observations for the purpose of ascertaining the nature and amount of changes taking place.

In 1867 a survey of the shore line of Long Beach was made.

In 1868 the officer in charge was directed by the Chief of Engineers to make "such resurvey of Bridgeport Harbor, Connecticut, as may be found necessary to ascertain what changes have occurred since the survey of 1866." In the report on this survey it was stated that the channel remained the same, and that no appropriation was needed until "the channel is found inadequate to the necessities of commerce, and then dredging must be resorted to."

In 1870 a petition of citizens of Bridgeport was presented to Congress asking that an appropriation "be made to remove said sand bar (the outer bar) and to widen and deepen said channel and harbor, in order that vessels drawing 12 feet of water may be enabled to enter without being grounded and without the aid of lighters," and a survey or examination of the harbor was ordered.

The work was then in charge of General Warren, U. S. Engineers. He made an examination of the harbor, and found it unnecessary to make further surveys. In his report, dated January 12, 1871, General Warren submitted a project for dredging a channel 100 feet wide and 12 feet deep at extreme low water (or 14 feet deep at mean low water), and for building a pier 3,000 feet long, extending out from Long Beach, to be partly of riprap, partly of dolphins. The estimated cost of the project was $124,000. After an appropriation of $20,000 was made, in 1871, work under this project was begun, dredging to depths of 12 and 13 feet at mean low water, and substituting a riprap jetty for riprap and dolphins. The jetty was completed, as far as deemed necessary, in 1873.

In 1875 the dimensions of the projected channel were modified so as to make it 12 feet deep at mean low water and from 200 to 300 feet wide. This was accomplished in 1882.

In 1878, in compliance with the terms of the appropriation act of that year, a channel 100 feet wide and 9 feet deep was dredged from the lower bridge to the horse railroad bridge, a distance of about 3,000 feet.

After the appropriation of 1882 a project for widening to 600 feet the channel between the Inner Beacon and the Naugatuck Railroad Wharf was adopted, to prevent overcrowding the main channel by vessels entering to seek refuge during storms. The estimated cost was $60,000. This is nearly completed, a small area near the Inner Beacon remaining to be dredged.

In November, 1887, a petition was sent to the Secretary of War, signed by the mayor and other citizens of Bridgeport, asking that $10,000 be appropriated for a channel 8½ to 9 feet deep and 100 feet wide above the horse railroad bridge. This petition, with indorsements and reports estimating $18,000 as the cost of such work, is printed in the Annual Report of the Chief of Engineers for 1889, Part I, pp. 697-699.

The appropriation act of 1888 authorized this work, and the project was therefore extended to include it.

March 8, 1889, a petition was addressed to the Secretary of War by the mayor and other citizens of Bridgeport, representing the necessity of a breakwater within the harbor of Bridgeport. This petition, with indorsements, is printed in the Annual Report of the Chief of Engineers for 1889, Part I, pp. 700-702. The indorsements estimate the cost of a breakwater from the Tongue to the Inner Beacon at about $30,000, and authorize the extension of the project to include this work.

The project for improving this harbor, as thus extended, consists—

1. In dredging to make and maintain a channel 12 feet deep at mean low water, and 300 feet wide, or more, from Long Island Sound to the lower bridge, nearly completed. Estimated cost to complete, $17,000.
2. In dredging to make and maintain a channel 9 feet deep and 100 feet wide from the lower bridge to the head of the harbor, partly completed. Estimated cost to complete, $3,000.
3. In building a breakwater from the Tongue to the Inner Beacon, partly finished. Estimated to cost $30,000, of which $15,000 have been appropriated.

It is probable that ultimately an extension of the east breakwater will be required, in order to prevent the shoaling of the outer bar.

Up to July 1, 1892, a breakwater had been built at Long Beach on the east side of the harbor entrance; the channel from Long Island Sound to the lower bridge had been dredged 12 feet deep and 300 feet wide or over, it being 770 feet wide between the Inner Beacon and the Naugatuck Railroad Wharf. Above the lower bridge the channel had been made 9 feet deep at mean low water, with width of 100 feet to the horse-railroad bridge; thence for a distance of about 2,600 feet (to within 25 feet of the upper landing in the harbor), with width from 90 to 60 feet. The breakwater from the Tongue to the Inner Beacon had been built to its full length, 1,165 feet, with a top width of 5 feet at 3 feet above high water, a cross section adopted in order to cover the whole distance at once, and thus prevent scouring on line of work.

Harbor lines for this harbor were established by the Secretary of War July 1, 1893.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1894.

Nothing was done.

PRESENT CONDITION OF IMPROVEMENT.

The 12-foot channel is 75 feet wide on the outer bar, but for 200 feet width there is a depth of 11 feet or over; thence across the inner bar and up to the Inner Beacon the 12-foot channel is about 300 feet wide;

thence up to the Naugatuck Railroad Wharf it is 770 feet wide; from that wharf to the lower bridge it has shoaled so that the present depth is from 10 to 11 feet.

The channel from the lower bridge to the horse-railroad bridge, dredged 9 feet deep and 100 feet wide in 1878, retains nearly that depth and width; the 9-foot channel above the horse-railroad bridge is from 60 to 90 feet wide, and about 2,600 feet long, extending to within 25 feet of the upper landing.

The breakwater at Long Beach has settled since it was built in 1871–1873; it still serves the purpose for which it was designed, and no repairs are now needed.

The project of 1882 for making 600 feet width of channel between the Inner Beacon and the Naugatuck Railroad Wharf was reported completed in 1887. A greater width (770 feet) was obtained in 1893. The Inner Beacon has since been rebuilt, and its location slightly changed, which makes it desirable to cut off a short point outside the new position of that beacon. This was partly done in 1888.

The breakwater from the Tongue to the Inner Beacon has been built to full length, but not to the cross section necessary for permanence.

PROPOSED OPERATIONS.

With future appropriations it is proposed to dredge to maintain the existing channels, to widen the channel above the Naugatuck Railroad Wharf eastward to the harbor line (about 200 feet), and to complete the channel above the bridges; also to complete the breakwater from the Tongue to the Inner Beacon by enlarging it to its projected cross section, if necessary. The estimated cost of the above work, not including what may be required for maintenance of channel, is, as heretofore reported, $35,000. The project could be completed to advantage in a single year and at the estimated cost.

The annual cost of maintaining the dredged channels in this harbor is estimated at $3,000.

Appropriations for the improvement of Bridgeport Harbor have been made as follows:

Application.	Date.	Amount.
Dredging outer bar	July 4, 1836	$10,000.00
Dredging outer and inner bars	Aug. 30, 1852	[illegible]0,000.00
Survey	June 23, 1866	1,985.38
Do	July 11, 1870	500.00
Dredging and 521 feet of breakwater	Mar. 3, 1871	20,000.00
Dredging and 859 feet of breakwater	June 10, 1872	40,000.00
Dredging inner bar and upper harbor	Mar. 3, 1873	30,000.00
Dredging bridge to Long Island Sound (9 feet)	June 23, 1874	20,000.00
Dredging bridge to Long Island Sound (12 feet)	Mar. 3, 1875	15,000.00
Dredging upper harbor (9 feet)	Aug. 14, 1876	10,000.00
Dredging above bridge and outer bar (9 and 12 feet)	June 18, 1878	10,000.00
Dredging bridge to Long Island Sound (12 feet)	Mar. 3, 1879	10,000.00
Do	June 14, 1880	10,000.00
Dredging above Inner Beacon (12 feet)	Mar. 3, 1881	10,000.00
Dredging between Inner Beacon and railroad wharf (12 feet)	Aug. 2, 1882	10,000.00
Do	July 5, 1884	5,000.00
Do	Aug. 5, 1886	20,000.00
Dredging above horse-railroad bridge (9 feet)	Aug. 11, 1888	10,000.00
Dredging and breakwater at Tongue	Sept. 19, 1890	20,000.00
Dredging between Inner Beacon and Naugatuck Wharf	July 13, 1892	20,000.00
Total		282,485.38

Bridgeport, the port of entry for the collection district of Fairfield, is situated about 2 miles from Long Island Sound, at the head of Bridgeport Harbor.

There is a light-house at the entrance to the harbor.

Fort Hale, New Haven Harbor, the nearest work of defense, is 18 miles east.

Money statement.

July 1, 1893, balance unexpended	$1,188.37
June 30, 1894, amount expended during fiscal year	843.97
July 1, 1894, balance unexpended	344.40
Amount (estimated) required for completion of existing project	35,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	35,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

COMMERCIAL STATISTICS FOR CALENDAR YEAR 1893.

Arrivals and departures of vessels.

[Draft, 6 to 18 feet; tonnage, 50 to 1,250 tons.]

Kind of vessels.	Number of round trips.	Aggregate tonnage of all trips.
Steamers	7,635	....
Sailing vessels	2,913	....
Barges	5,601	....
Total	16,149	1,229,533

Cargoes.

	Tons.	Estimated value.
Receipts	610,233	$28,446,667
Shipments	272,560	27,752,667
Total	882,793	56,199,334

Number of vessels repaired during 1893, 79.

The above figures show a total tonnage of freight of 882,793 tons, being a decrease of 441,397 tons since the last report received (1892), when 1,324,190 tons were reported. The large difference is stated to be due to the general depression of business during 1893, and to the damage done to the oyster industry by the severe autumn gales.

No new line of transportation has been established since July 1, 1893.

D II.

IMPROVEMENT OF BLACK ROCK HARBOR, CONNECTICUT.

This harbor, 1½ miles long from northeast to southwest and 300 to 2,500 feet wide, lies between the mainland on the west and Fayerweather Island on the east, and includes the navigable part of Cedar Creek, a small tidal inlet which extends up into the western part of the city of

Bridgeport, and affords water communication of great value to several large manufactories in its immediate neighborhood. It is in the interest of the city of Bridgeport that the improvement of Black Rock Harbor is desired.

The depth in the lower part of the harbor is from 6 to 12 feet at mean low water. This part of the harbor was formerly much used as a refuge for vessels overtaken by storms, but it is not deep enough for most vessels now engaged in commerce through the sound. Before work was done in Cedar Creek the depth there was from 2 to 4 feet, and the channel was narrow and crooked.

The head of the harbor was separated from Long Island Sound on the southeast by a broad, flat sand bar, which was bare at about half tide, and which joined Fayerweather Island with the mainland.

PROJECTS FOR IMPROVEMENT.

Between 1836 and 1838 $21,500 were expended in building a sea wall across a breach in the southern part of Fayerweather Island, to preserve the light-house reservation at the south end of the island and to prevent shoaling on the anchorage ground.

In 1882 a survey of the harbor was ordered by Congress, which was made in 1883. In his report on this survey, dated December 12, 1883, Col. McFarland, U. S. Engineers, submitted a project, providing—

1. For protecting the upper part of the harbor from the sea by building a breakwater over the bar northeast of Fayerweather Island, to be about half a mile long and 6 feet wide at the top, which was to be 3½ feet above mean high water or 10 feet above low water.

2. For making a channel 80 feet wide and 6 feet deep at mean low water, extending up Cedar Creek.

The estimated cost was—

Breakwater	$58,000
Dredging	22,000
Total	80,000

Work under this project was begun in 1885, and up to July 1, 1893, the breakwater had been built to its full length in order to prevent the currents from cutting a channel across the bar, but its cross section was less than designed both in height and width; also a channel 6 feet deep or over had been dredged, with width of 80 feet, extending from deep water northward up Cedar Creek to within 500 feet of the head of the creek, being 2,200 feet north of the Forge Company's Wharf. This channel was further widened and deepened in places by private parties.

A sketch of Black Rock Harbor was printed in the Annual Report of the Chief of Engineers for 1893, p. 944.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1894.

At the beginning of the year a contract for dredging about 25,000 cubic yards of material, at the rate of 17 cents per yard, was in force, entered into with Alonzo J. Beardsley October 10, 1892.

Work under this contract was begun November 17, 1893, and the contract was completed under extension January 5, 1894. Twenty-five thousand cubic yards of sand and mud were dredged, widening the channel opposite Fancher's Dock, Black Rock, and removing shoals from the channel for about one-half mile above that dock, giving it the full projected width and depth.

The violent storms of August 24 and August 29, 1893, caused considerable damage at the north end of the old sea wall on Fayerweather Island, built in 1836–'38. A gap of about 120 feet in length was made at the north end of the wall, and it was first reported, as appearances indicated, that such a length of wall had been washed away. Careful measurements were made subsequently, which showed that but a small part of the wall had disappeared—not more than 10 or 12 feet—and that the rest of the gap was occasioned by the washing away of the island just north of the wall down to about ordinary high-water level. For about 110 feet south of the gap the wall had sustained very considerable injury and slight injury at several points farther south. There was great danger that, unless promptly repaired, the damage would be increased by ordinary storms. The funds available for Black Rock Harbor were covered by an existing contract, and the repair of this old sea wall, though frequently referred to in annual reports, was not included in the project for improvement for which appropriations had been made. Upon reporting the facts to the Chief of Engineers, with an estimate of $3,500 as the cost of properly repairing this sea wall, the amount was allotted for this purpose from the appropriation of July 13, 1892, for "Examinations, surveys, and contingencies of rivers and harbors."

Thirteen hundred and eighty-four tons of stone were purchased and placed in the work, of which 811 tons were quarry stone, at $2 per ton, and 573 tons were picked up from a reef at the south end of the island, at $1.75 per ton. One hundred and fifteen linear feet of the old wall were rebuilt and 160 feet of new wall added, extending the work northwardly to the high sand bank, and minor repairs were made to other parts of the wall.

Work was done by hired labor and purchase of material in open market, as being the method most economical and advantageous to the Government. It was completed May 11, 1894.

PRESENT CONDITION OF IMPROVEMENT.

The breakwater between Fayerweather Island and the mainland is built to its full length, 2,744 feet, but not to the cross section first proposed. So far it serves the purpose for which it was designed, and its enlargement is not necessary at present.

The 6-foot channel has been dredged to the head of navigation in Cedar Creek, the east branch of the harbor, with full projected depth and width. Additional dredging to widen and deepen the channel in places has been done by private parties.

Of the project of 1885 there remains only the enlargement of the breakwater, and as this is not necessary at present, the project is considered completed.

The sea wall built across a breach in Fayerweather Island in 1836–'38, and repaired in 1894, still closes the breach and preserves the island. The parts repaired and rebuilt are in good condition, but during the winter of 1893–'94 considerable damage was done to other parts of the wall by the unusually severe storms. Part of the wall was undermined, and to make the structure secure quite extensive repairs at several points are necessary, amounting in aggregate probably to slightly more than was done during the past season.

PROPOSED OPERATIONS.

The project for this improvement has been completed as far as is now necessary, and no further work under it is now proposed.

When funds can be made available, it will be desirable to thoroughly repair the old sea wall on Fayerweather Island.

Appropriations for the improvement of Black Rock Harbor, Connecticut, have been made as follows:

Application.	Date.	Amount.
Building sea wall on Fayerweather Island	1836-'38	$21,500
Survey	Aug. 2, 1882	350
Building breakwater and dredging	July 5, 1884	20,000
Dredging	Aug. 5, 1886	5,000
Do	Aug. 11, 1888	10,000
Do	Sept. 19, 1890	5,000
Do	July 13, 1892	5,000
Total		66,850

Black Rock Harbor is in the Fairfield collection district, of which Bridgeport is the port of entry. There is a light-house at the harbor entrance. Fort Hale, New Haven Harbor, the nearest work of defense, is 20 miles east.

Money statement.

July 1, 1893, balance unexpended	$4,969.66
June 30, 1894, amount expended during fiscal year	4,664.47
July 1, 1894, balance unexpended	305.19

Abstract of contract for improving Black Rock Harbor, Connecticut, in force during the fiscal year ending June 30, 1894.

Name and address of contractor.	Date of contract.	Subject of contract.	Price per cu. yd.	Remarks.
Alonzo J. Beardsley, Bridgeport, Conn.	Oct. 10, 1892	Dredging	$0.17	Contract completed under extension January 5, 1894; total amount dredged, 25,000 cubic yards.

COMMERCIAL STATISTICS FOR CALENDAR YEAR 1893.

[Furnished by courtesy of Capt. John McNeil, harbormaster at Bridgeport, Conn.]

Freight received and shipped by water.

Chief articles.	Tons.	Estimated value.
Coal, iron, and sand	45,905	$169,034.95
Miscellaneous (not otherwise included)	8,670	
Total	54,575	169,034.95

Arrivals and departures of vessels used in above traffic.

[Draft, 6 to 12 feet; tonnage, 95 to 350 tons.]

Kind of vessels.	Number of vessels.	Number of round trips.	Aggregate tonnage of all trips.
Steamers	35	796	54,575
Sailing vessels	55		
Barges	208		
Total	298	796	54,575

The above figures show an increase in tonnage of freight of 2,122 tons over that reported for 1892.

No new line of transportation has been established since July 1, 1893.

D 12.

IMPROVEMENT OF SAUGATUCK RIVER, CONNECTICUT.

The navigable part of this river is a tidal inlet extending from the village of Westport southerly to Long Island Sound, a distance of about 4½ miles by course of channel. For nearly 2 miles below Westport the stream is only from 200 to 1,200 feet wide; below this it expands into a rather broad inner bay with a narrow channel following the west, south, and east shores, and then turning abruptly to the southeast and passing to the sound between Cedar Point on the north and Cockenoes Island on the south. On the south side of the inner bay lies "Great Marsh," which is connected with Cockenoes Island by a broad sand flat nearly bare at low tide, and east of the island a reef of bowlders extends eastward 1½ miles; so that the only entrance to the harbor at low tide is to the eastward of this reef.

A mile and a half below Westport lies the settlement and railroad station of Saugatuck on the west bank of the river. Before 1830 the village of Westport was known as Saugatuck.

The navigable part of the river is crossed by three bridges, all having draws of sufficient size for the commerce of the stream. The uppermost is a wagon bridge at Westport; a mile and a quarter below is a wagon bridge near Saugatuck, and a quarter mile farther down is the bridge of the New York, New Haven and Hartford Railroad.

The mean rise of tide is about 7 feet.

From Long Island Sound to the railroad bridge the natural available depth of water was about 5½ feet at mean low tide, with a channel generally narrow and circuitous; above the railroad bridge the channel was fairly straight with a low-water depth diminishing to practically nothing at Westport. Several rocks lying in or close to the channel are sources of some danger to navigation.

PROJECTS FOR IMPROVEMENT.

Improvements at this locality have been made by the United States under the several titles of Saugatuck Harbor, Cedar Point, Westport Harbor, and Saugatuck River.

Upon petition of citizens of Westport (then Saugatuck) Congress appropriated, May 20, 1826, $400 for a survey of the river and harbor of Saugatuck, in order to determine "the expediency and expense of removing the obstructions to navigation" in the river and "of facilitating the commercial intercourse between the port of Saugatuck and the city of New York." The survey was made by Lieut. Col. Anderson in 1826, and in his report a project for improvement was submitted, consisting in deepening the channel by from 1 to 1½ feet from Westport for 459 yards downstream, removal of two rocks in the river, and building a breakwater on Cedar Point to prevent its washing away, all at a cost of $600; and further, in cutting a canal through "Great Marsh" to save the distance around Cockenoes Island for west-bound vessels, excavating and banking up 31,860.94 cubic yards of material at a cost of $5,628.65, the total cost of the projected improvement being $6,128.65. This did not include stone for a wall along part of the east bank of the canal, which it was stated could be procured at small cost if needed.

Under this project six different appropriations were made and the work was completed, practically as designed, in 1839.

It is not known what dredging was done in the river or what obstructions were removed, but the amount of such work is believed to be small.

The breakwater on Cedar Point was begun in 1827 and completed in 1837. It was made about 390 feet long and 10 feet wide on top, the top being 4 feet above mean high water, under two appropriations—one of $1,500, March 2, 1827, for removing obstructions in the river and protecting the harbor at Cedar Point, and one of $1,000, July 4, 1836, for further securing the beach at Cedar Point. It is believed that nearly all of both appropriations was applied to the breakwater.

In 1836–'40, the canal was cut through Great Marsh, extending from a bend in the channel of the inner bay to the sound, and thus saving the distance around Cockenoes Island and the reef east of it, and shortening the distance between Westport and points west by about 4 miles. The canal was made 68 feet wide at high water, 44 feet wide at bottom, and was 1,350 feet long, exclusive of the dredging required to connect it with deep water at either end. It was first made 2 feet deep at mean low water and subsequently, under appropriation of July 7, 1838, deepened to 4 feet. Part of the east side was also protected by a dry wall, and in line of this wall a beacon was built to mark the entrance from the sound. The canal was built under three appropriations for improving Westport Harbor, made in 1836, 1837, and 1838, and aggregating $11,516. It filled up so rapidly that since 1850 it has been of little use.

The next appropriation made for this harbor was $2,500, March 2, 1867. Proposals were invited for extending the sea wall on Cedar Point and for removing three rocks above the railroad bridge, but the prices offered were considered too high; $410.10 were expended in advertising, in examination of the harbor, and preparing estimates of cost of work, and it was reported that the work necessary was removal of rocks, extension and repair of sea wall, and repair of canal and canal wall, at a probable cost of $12,150. The unexpended balance of this appropriation reverted to the Treasury by act of Congress of July 12, 1870, but was reappropriated by act of March 3, 1871.

July 11, 1870, $2,500 were appropriated for improving Westport Harbor, which was expended the same fiscal year in repair of the breakwater on Cedar Point. About 64 feet of the old work were rebuilt and it was extended northwardly 43¾ feet, making its total length about 434 feet; the new work was 5½-feet width on top and from 1 to 1½ feet higher than the old wall.

The reappropriated balance of the appropriation of 1867 was considered too small to effect any useful improvement, and was applied in 1872 to making a survey of the whole length of the river and harbor.

In 1883 an examination of this harbor was made in pursuance of the river and harbor act of August 2, 1882. The officer in charge recommended that the canal be abandoned, and that a survey be made to determine the cost of excavating a channel 4 feet deep up to the village of Westport as being an improvement worthy to be made, provided it could be done at reasonable cost. A survey was made in accordance therewith, and an estimate of $36,000 submitted for such a channel, to be 100 feet wide, including removal of a few bowlders in and near the channel. (See Annual Report of the Chief of Engineers for 1884, Part II, p. 675.)

In 1886 certain citizens of Westport addressed a petition to the Secretary of War urging the reopening of the canal through Great Marsh. This petition was printed, in connection with the report upon a preliminary examination, in the Annual Report of the Chief of Engineers for 1891, p. 841.

The river and harbor act of 1890 directed a preliminary examination of Saugatuck River, which was made and reported upon under date of January 8, 1891. (Report printed in House Ex. Doc. No. 179, Fifty-first Congress, second session, and in the Annual Report of the Chief of Engineers for 1891, p. 840.)

In the report estimates were presented—

1. For a channel 100 feet wide and 6 feet deep at mean low water up to the village of Westport	$40,000
2. For a channel 60 feet wide and 4 feet deep at mean low water to Westport	10,000
3. For reopening the canal, making it 100 feet wide and 5 deep at mean low water	21,000

with recommendations that the improvement of the natural channel should precede any work on the canal.

The river and harbor act of 1892 directed a preliminary examination of Westport Harbor, which was made in the same year and reported upon November 1, 1892. The report (printed in the Annual Report of the Chief of Engineers for 1893, p. 990, and also in House Ex. Doc. No. 114, Fifty-second Congress, second session) stated the harbor to be worthy of improvement, and submitted an estimate of $500 as the cost of a survey "to determine what further improvements are necessary and to make a project and estimate of their cost."

By the same act of 1892, $7,000 were appropriated for improving Saugatuck River, "to be expended in the improvement of the natural channel," and by approval of the Secretary of War, July 21, 1892, the project was adopted providing for a depth of 4 feet and width of 60 feet to the village of Westport, at an estimated cost of $10,000.

Up to July 1, 1893, 3,651 cubic yards of material had been dredged under this project, extending the 4-foot channel about 900 feet toward Westport, with width of 60 feet; the contract for dredging was in progress.

No sketch of this river and harbor has appeared in the annual reports of the Chief of Engineers previous to 1894.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1894.

At the beginning of the year dredging was in progress, under a contract with E. R. Seward, for removing about 22,000 cubic yards of material at 27 cents per cubic yard. Work was continued until November 10 under an extension of contract, at which time the contract was completed, 12,991 cubic yards of sand and small stones being removed since the beginning of the fiscal year.

The total amount dredged under the contract was 16,642 cubic yards; the channel was made 4 feet deep at mean low water from the 4-foot curve northwardly 3,285 feet, the lower 2,735 feet being made 60 feet wide and the upper 550 feet 40 feet wide. The channel extends to and about 15 feet beyond the south corner of the lower wharf on the east side of the river at Westport, and terminates at a ridge of bowlders under the bottom, which the available funds were not sufficient to remove.

PRESENT CONDITION OF IMPROVEMENT.

The condition of the channel of the river is as above described, this being the only dredging done there as far as known.

The Cedar Point breakwater is partly undermined at its north end, and the canal bottom is bare in places at extreme low tide. Work at those places is not included under the existing project, but is to be considered if the survey of Westport Harbor is ordered, as recommended in the report upon the preliminary examination of 1892.

PROPOSED OPERATIONS.

With future appropriations it is proposed to complete the 4-foot channel to Westport, as contemplated by the approved project.

Appropriations for this harbor have been made as follows:

Title.	Application.	Date.	Amount.
Survey of river and harbor of Saugatuck.	Survey	May 20, 1826	$400.00
Removing obstructions in river and protecting harbor at Cedar Point.	Chiefly constructing breakwater at Cedar Point.	Mar. 2, 1827	1,500.00
Removing obstructions in river	As stated, location not known	Apr. 30, 1830	28.00
For further securing the beach at Cedar Point.	Continuing breakwater	July 4, 1836	1,000.00
Harbor of Westport	Canal construction	July 4, 1836	3,000.00
Do	do	May 3, 1837	3,754.00
Do	do	July 7, 1838	4,782.00
Deepening and improving Westport Harbor, unexpended balance reverted to Treasury in 1870, reappropriated in 1871.	Chiefly in surveys in 1872	Mar. 2, 1867	2,500.00
Westport Harbor	Repairing and extending breakwater on Cedar Point.	July 11, 1870	2,500.00
Saugatuck River, improvement of the natural channel.	Dredging	July 13, 1892	7,000.00
Total			26,444.00

The appropriations prior to 1870 are taken from House Ex. Doc. No. 64, Forty-eighth Congress, first session. The last appropriation of $7,000 is the only one made under the existing project.

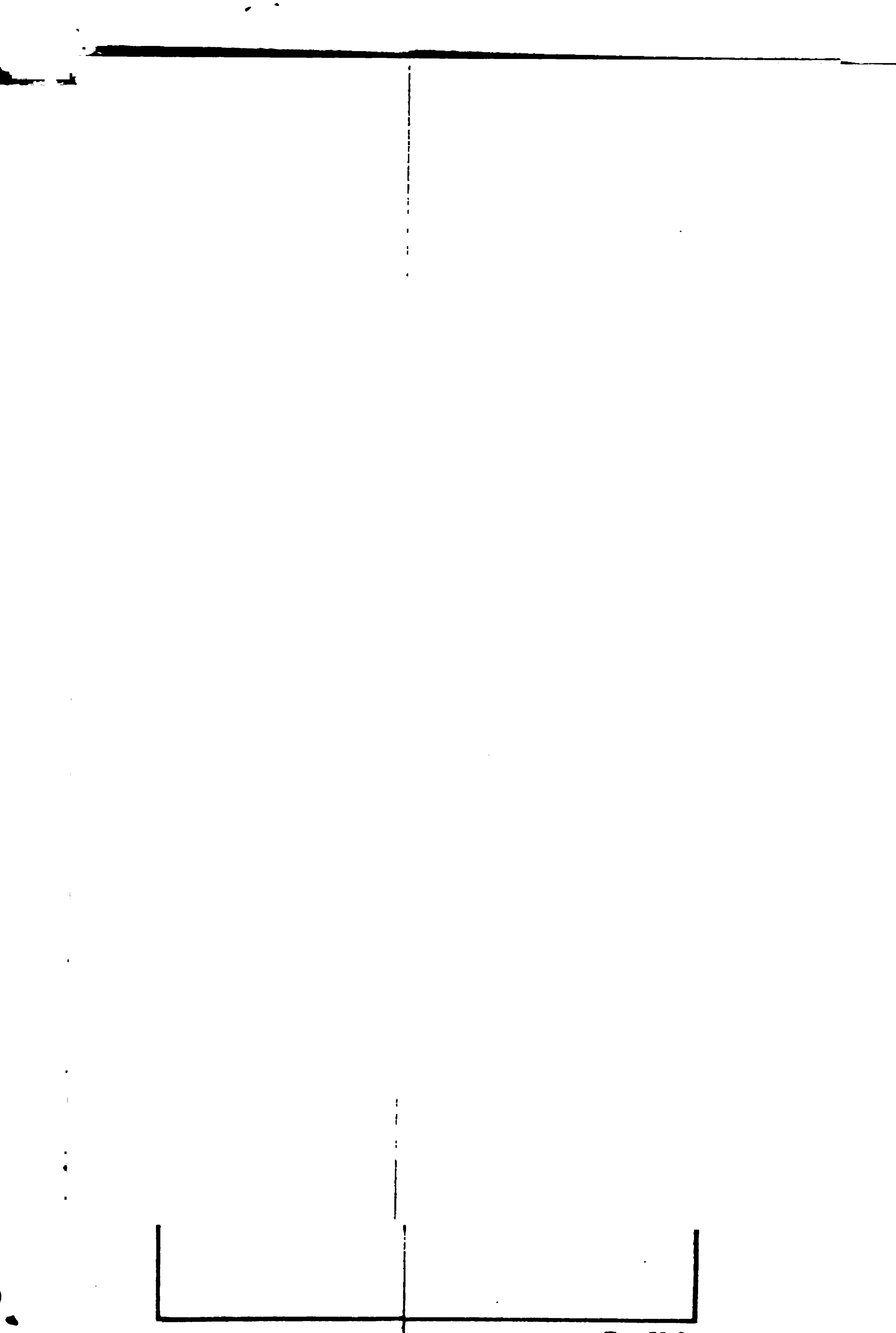
Saugatuck River is in the Fairfield collection district, of which Bridgeport is the port of entry.

The nearest light-house is on Sheffield Island, 5 miles southwest from the river's mouth.

Fort Hale, New Haven Harbor, about 27 miles east, is the nearest work of defense.

Money statement.

July 1, 1893, balance unexpended	$6,029.07
June 30, 1894, amount expended during fiscal year	5,150.12
July 1, 1894, balance unexpended	878.95



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Amount (estimated) required for completion of existing project	$3,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	3,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

Abstract of contract for improving Saugatuck River, Connecticut, in force during the fiscal year ending June 30, 1894.

Name and address of contractor.	Date of contract.	Subject of contract.	Price per cubic yard.	Remarks.
E. R. Seward, Albany, N. Y.	Feb. 25, 1893	Dredging	$0.27	Contract completed under extension Nov. 10, 1893. Total dredged, 16,642 cubic yards.

COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1893.

[Through the courtesy of Mr. E. M. Lees, Westport, Conn.]

Arrivals and departures of vessels.

[Draft, 6 to 11 feet; tonnage, 100 to 300 tons.]

Kind of vessels.	Number.	Number of round trips.	Aggregate tonnage of all trips.
Steamers	1	50	15,000
Sailing vessels	30	112	16,800
Barges	28	60	12,000
Total	59	222	43,800

Freight received and shipped by water.

Chief articles.	Tons.
Receipts:	
Coal	8,600
Lumber	3,800
Miscellaneous (not otherwise included)	20,000
Total receipts	32 400
Shipments:	
Farm produce	12,000
Total shipments	12,000

No new lines of transportation have been established since July 1, 1893.

No statistics were received for the year 1892, and the annual increase or decrease of tonnage can not therefore be determined.

D 13.

IMPROVEMENT OF HARBOR AT WILSONS POINT, CONNECTICUT.

Wilsons Point Harbor is a bay on the north shore of Long Island Sound, about 1½ miles west from the mouth of Norwalk River or Harbor.

The lower half of the harbor is about half a mile wide, with depth decreasing from 16 feet gradually to 6 feet at Wilsons Point; the upper half is from 1,000 to 500 feet wide, with depth of 3 feet or less at low tide. The harbor is sheltered by the mainland and by Sheffield Island (the most westerly of the Norwalk Islands) from all quarters except the southwest; it is partly sheltered from the southwest by Bell Island, an island separated from the mainland by a marsh and narrow creek.

Wilsons Point Harbor has been used to some extent for many years as a harbor of refuge and place to lie up for the night by fishing boats and oyster steamers, and occasionally by barges caught out in storms.

There is no settlement upon the shores of the harbor, except a collection of summer cottages on Bell Island.

A few years ago (probably about 1880) the Danbury and Norwalk Railroad Company (now a branch of the Housatonic Railroad Company) made Wilsons Point their terminus, and subsequently the New England Terminal Company was formed to construct docks, car yards, and coal sheds, and to operate in the interest of the Housatonic Railroad and its connections. A large dock was built with transfer bridges, by which freight cars were taken on board steamers and freight carried to New York City without unloading and reloading.

At that time the Housatonic Railroad was allied to the New York and New England Railroad system, which had no direct access to New York City so available as that afforded by the harbor at Wilsons Point. Subsequently (about 1892) the Housatonic Railroad was leased by another corporation, the New York, New Haven and Hartford Railroad, which had other and better entrances to New York City, and the terminal facilities at Wilsons Point have been very little used since.

PROJECTS FOR IMPROVEMENT.

March 3, 1888, a letter was sent by the Hon. William P. Frye, U. S. Senator, to the Secretary of War, asking that a special examination of Norwalk Harbor be made with reference to developing business which urgently required further improvements. This letter was referred to Col. D. C. Houston, Corps of Engineers, for report. His report (printed in the Annual Report of the Chief of Engineers for 1889, p. 709) stated that it was learned that the business referred to was that of the railroad terminus at Wilsons Point, and that it was desired that the United States undertake dredging a channel 15 feet deep and 300 feet wide up the harbor to the vicinity of the railroad wharves. There was no money available for a detailed examination of the locality, but estimates for dredging, based upon recent U. S. Coast Survey charts, were made as follows:

230,000 cubic yards, at 20 cents	$46,000
Contingencies, 15 per cent	6,900
Total	52,900

The report suggested that there seemed to be no objection to extending the wharves out to the 15-foot curve, which would obviate the necessity of other improvements.

The river and harbor act of 1888 made appropriations for Norwalk Harbor, Connecticut, of $28,000, with provision as follows:

Twenty-five thousand dollars of which shall be expended in dredging and deepening the channel in the lower harbor, up to Wilsons Point.

Under this appropriation the dredging originally desired was completed in 1889, 205,586 cubic yards of material being dredged, which, with a considerable amount of work done by the Terminal Company, gave a channel of 400 feet width; and no further appropriation was asked for.

In 1890 $30,000 were appropriated for this harbor, and were expended in 1891-'92 in widening and extending the channel.

Up to July 1, 1893, the channel close to the docks had been dredged by the Terminal Company to 12 feet depth at mean low water; outside this the channel had been made 15 feet deep at mean low water to Long Island Sound, and 700 feet wide with an additional width of 200 feet on the east side for a distance of 750 feet south from the wharves; the 15-foot channel had also been extended northward parallel to the wharves and 75 feet westward from them, with 200 feet width.

A sketch of the harbor at Wilsons Point was printed in the Annual Report of the Chief of Engineers for 1893, p. 950.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1894.

Nothing was done.

PRESENT CONDITION OF IMPROVEMENT.

The channels, as above described, remain in good condition.

PROPOSED OPERATIONS.

The improvement of this harbor is completed as far as now designed; no further work is projected and no appropriation is required.

Appropriations for improving harbor at Wilsons Point have been made, as follows:

Application.	Date.	Amount.
Dredging*	Aug. 11, 1888	$25,000
Do	Sept. 19, 1890	30,000
Total		55,000

* Part of an appropriation of $28,000 for Norwalk Harbor, directed by the appropriation act to be expended at Wilsons Point.

Wilsons Point is in the Fairfield collection district, and is about 14 miles southwest from Bridgeport, the port of entry.

Norwalk light-house, on Sheffield Island, is about half a mile south of the harbor.

The nearest work of defense is Fort Schuyler, Throgs Neck, at the head of Long Island Sound, about 29 miles southwest.

Money statement.

July 1, 1893, balance unexpended	$1,323.10
July 1, 1894, balance unexpended	1,323.10

COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1893.

[Through courtesy of Mr. E. J. Hill, Norwalk, Conn.]

Arrivals and departures of vessels.

[Draft, 4 to 18 feet; tonnage, 50 to 560 registered net tons.]

Kind of vessels.	Number of round trips.
Steamers (including oyster steamers)	450
Sailing vessels	18
Barges	268
Total	736

Aggregate tonnage of all trips not ascertained.

Freight received and shipped by water.

Chief articles.	Tons.
Receipts:	
Oil	30,000
Coal	45,552
Miscellaneous (not otherwise included)	1,000
Total receipts	76,552
Shipments, miscellaneous	1,200

Estimated value not ascertained.

No new lines of transportation have been established since July 1, 1893.

No statistics of commerce of this harbor have been received since 1890, when 221,202 tons were reported. The local conditions have very much changed since 1890, and there is no prospect that the amount of business in the harbor will again reach the figures for that year.

D 14.

IMPROVEMENT OF FIVE MILE RIVER HARBOR, CONNECTICUT.

This harbor is an inlet on the north shore of Long Island Sound, about 2 miles west of the mouth of Norwalk Harbor, Connecticut. It is about one mile long and from 300 to 800 feet wide. About three-quarters of a mile above its mouth it runs bare at low tide. At the mouth the natural low-water depth was 3 feet, increasing to 9 feet at a point 750 feet out into the sound. The mean rise of tide is about 7 feet.

Since 1848 Five Mile River has been largely engaged in oyster-growing, and in this business now employs about 140 vessels.

These vessels could only enter or leave the harbor at high tide. Consequently during their busy season they were obliged to lie up for the night at other and less convenient harbors.

PROJECT FOR IMPROVEMENT.

By act of Congress approved August 5, 1886, a survey or examination of this harbor was ordered, which was made in the following fall, and reported on under date of December 7, 1886. (Report printed in the Annual Report of the Chief of Engineers for 1887, Part I, p. 639.)

In this report a project for improvement was proposed which consisted in dredging a channel 8 feet deep at mean low water and 100 feet wide, to extend up the harbor, and to be about 6,000 feet long. The estimated cost was $25,000. This project was adopted in 1888, when work under it was ordered by the appropriation of $5,000 made by act of Congress of August 11, 1888.

Up to July 1, 1893, 52,938 cubic yards had been dredged under this project, making the channel about 2,450 feet long, 60 feet wide, and 8 feet deep at mean low water.

Harbor lines were established in this harbor by the Secretary of War, January 26, 1892.

A sketch of this harbor and vicinity from U. S. Coast and Geodetic Survey charts was printed in the Annual Report of the Chief of Engineers for 1889, p. 708.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1894.

At the beginning of the fiscal year a contract for dredging was in force, entered into with Alonzo J. Beardsley, October 10, 1892, for removing about 30,000 cubic yards of material at 14½ cents per cubic yard. Under extension of this contract to October 31, 1893, dredging was begun September 9 and completed October 20, 1893, 30,000 cubic yards of sand and mud having been removed.

The channel of 8 feet depth at mean low tide with width of 60 feet was extended 1,130 feet farther upstream.

After completion of the contract certain parties owning docks on the east side of the river took prompt advantage of the improvement by themselves dredging to connect their docks with deep water.

PRESENT CONDITION OF IMPROVEMENT.

Under the existing project the channel has been dredged from deep water in Long Island Sound, about 3,580 feet up the harbor, with width of 60 feet and depth of 8 feet at mean low water. It retains its depth fairly well, the only shoaling reported being a slight falling in of the banks.

PROPOSED OPERATIONS.

With future appropriations it is proposed to widen and extend the channel as provided for in the project for improvement.

REVISED ESTIMATE OF COST OF COMPLETION OF PROJECT.

The original estimate of the cost of this improvement was $25,000, which was intended to cover dredging about 220,000 cubic yards of mud, at 10 cents per yard, with 15 per cent added for contingencies, supervision, etc. The number of yards, computed from U. S. Coast Survey charts, and from observations made during preliminary examination, was fairly accurate. The price, based upon the current prices of works in that vicinity, let by contract in 1886, was too low. The current prices for that year were lower than they have been since, as appears from the following table of prices for work in that vicinity:

Prices per cubic yard for dredging in the years named.

	1887.	1889.	1891.	1893.
	Cents.	*Cents.*	*Cents.*	*Cents.*
Bridgeport Harbor	5.9	18	14.6	9½
Black Rock Harbor	9	16	14.6	17
Norwalk Harbor	11½	15	14.6	No work.
Five Mile River Harbor	Not begun.	*17	14.6	14.5
Stamford Harbor	15.7	18	20	16½

*Contract was per hour, but cost was 17 cents per yard. Bridgeport prices for 1889 and 1891 should not be used in comparison, as the character of work was not the same as in 1887 and 1893.

Up to the present time 82,938 cubic yards have been dredged from Five Mile River Harbor at an actual cost of $12,725, being 15.3 cents per cubic yard, and there remains to complete the project, as nearly as can be estimated, 160,000 yards to dredge, which, at the same rate, and allowing 15 per cent for contingencies and supervision, would cost $28,152. If appropriations are made in amounts of about $5,000 each, as they have been heretofore, the expense of maintenance would somewhat increase as the channel becomes longer, and it is not safe now to put the cost of completion, including maintenance during progress of the work, at less than $30,000.

It is manifest that the work projected cannot be completed with the balance of the original estimate, $10,000. If the prices which have been current since 1887 could have been foreseen, and if sufficient allowance had been made for additional dredging to maintain the channel until completion, the original estimate should have provided for:

Dredging 255,000 cubic yards, at 15.3 cents	$39,015
Contingencies and supervision, about 15 per cent	5,985
Total estimated cost	45,000

With approval of the Chief of Engineers, therefore, the estimate for completion is herein changed to $30,000, and the estimated cost from the beginning, as revised in 1894, is put at $45,000.

Appropriations for improving harbor at Five Mile River, Connecticut, have been made as follows:

Application.	Date.	Amount.
Dredging	Aug. 11, 1888	$5,000
Do	Sept. 19, 1890	5,000
Do	July 13, 1892	5,000
Total		15,000

Five Mile River is in the Fairfield collection district and is about 13 miles west of Bridgeport, the port of entry.

The nearest light-house is on Sheffield Island, nearly 2 miles from the mouth of the harbor.

The nearest work of defense is Fort Schuyler, at the head of Long Island Sound, 27 miles southwest.

Money statement.

July 1, 1893, balance unexpended	$5,028.58
June 30, 1894, amount expended during fiscal year	4,694.43
July 1, 1894, balance unexpended	334.15
Amount (estimated) required for completion of existing project	30,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	10,000.00

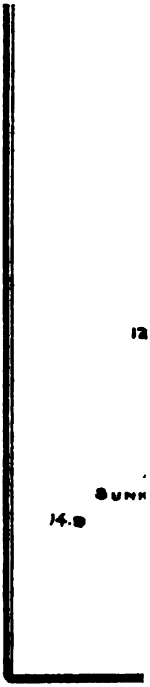
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

Abstract of contract for improving harbor of Five Mile River, Connecticut, in force during the fiscal year ending June 30, 1894.

Name and address of contractor.	Date of contract.	Subject of contract.	Price per cubic yard.	Remarks.
Alonzo J. Beardsley, Bridgeport, Conn.	Oct. 10, 1892	Dredging	$0.14½	Contract completed under extension Oct. 20, 1893; amount removed, 30,000 cubic yards.

COMMERCIAL STATISTICS FOR CALENDAR YEAR 1893.

Commercial statistics have been asked for, but up to date of this report have not been received.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D 15.

IMPROVEMENT OF STAMFORD HARBOR, CONNECTICUT.

This harbor is on the north shore of Long Island Sound, about 6 miles east of the New York State line. The harbor consists of a bay about a mile long and a mile broad, at the head of which two channels extend up nearly a mile toward the middle of the city. The west branch is the mouth of Mill River, a small stream dammed at Oliver street bridge, the head of the harbor; the original low-water depth for a mile below the bridge was from 1 to 3 feet in a crooked channel, and the 7-foot curve in the bay was about 7,500 feet below the bridge; all the wharves are in the upper half of this distance. The east branch was originally a crooked stream running through salt marshes; it was straightened and deepened by private enterprise, and was known as the "canal." Though nominally under control of the corporation which deepened it, the east branch has been for a long time practically, and recently has been formally, opened to free public use. In 1892 it had an available depth of 6½ feet at mean low water, with width of about 60 feet nearly to its head.

The mean rise of tide in Stamford Harbor is about 7.9 feet.

PROJECTS FOR IMPROVEMENT.

By act of March 2, 1829, Congress appropriated $100 for making a survey of the harbor of Stamford, Conn., with a view to its improvement. The survey was made by Capt. Hartmann Bache, U. S. engineers, in 1829. In his report on the same, dated May 10, 1830, Capt. Bache recommended excavating the channel (proposing to build a steam dredge for the purpose), the cost being estimated as follows:

For a channel 12 feet deep at ordinary high water (about 4 feet at mean low water)	$13,250.00
For a channel 10 feet deep at ordinary high water	11,035.20

No money was appropriated for carrying out this plan.

The river and harbor act of 1882 authorized a survey of this harbor, which was made in the following year. In his report on this survey, dated December 12, 1883 (printed in Senate Ex. Doc. No. 50, Forty-eighth Congress, first session; also in Annual Report of the Chief of Engineers for 1884, part 1, p. 672), Lieut. Col. McFarland, Corps of Engineers, submitted a project for dredging a channel 80 feet wide and 5 feet deep at mean low water from deep water in the bay up the west branch of the harbor to Oliver street bridge, estimated to cost as follows:

Dredging 80,000 cubic yards of mud, at 20 cents	$16,000
Contingencies	4,000
Total	20,000

It was not intended to include the removal of the ledge under and just below the bridge.

The beginning of the work under this project was approved by the Secretary of War August 30, 1886, after the first appropriation for improving the harbor had been made, and in December, 1891, after appropriations equal to the estimated cost of the work had been made and expended, the project was considered practically completed. The channel of the west branch had been made 5 feet deep at mean low water and about 80 feet wide up to within 1,000 feet of the head of the harbor. Near the head of the harbor the width was from 50 to 70 feet; at the bends of the channel the width had been made from 100 to 140 feet.

Under the river and harbor act approved September 19, 1890, a survey of Stamford Harbor was made, the report on which, dated September 16, 1891, was printed in the Annual Report of the Chief of Engineers for 1891, Part I, p. 849 *et seq.* This report presents a project for enlarging the channel of the west branch of the harbor to accommodate the growing commerce of Stamford, and estimates were submitted as follows:

Dredging to make the channel 150 feet wide and 7 feet deep at mean low water: 190,000 cubic yards, at 21 cents	$39,900	
Contingencies and supervision, about	6,100	
		$46,000
Dredging to make the basin between harbor lines at the head of the harbor 7 feet deep: 150,000 cubic yards, at 28 cents	42,000	
Contingencies and supervision, about	7,000	
		49,000
Total estimated cost		95,000

The river and harbor act of July 13, 1892, appropriated $15,000 for improving harbor at Stamford, Conn., with proviso that not less than one-half the sum should be expended on the east branch. This appropriation was evidently based upon the survey of 1890-'91, which was before Congress at the time, and also upon a desired improvement of the east branch, which had not been asked for at the time when the survey was made. Therefore the east branch was surveyed and a project submitted for making the channel 9 feet deep at mean low water, to be 100 feet wide for a length of 8,535 feet, and 50 feet wide for about 1,200 feet to the head of navigation, by dredging and removing rocks and bowlders, at an estimated cost of $28,500. The plans for improvement of both branches were adopted, and the project of 1892 now consists of:

Dredging to make the channel in the west branch 150 feet wide and 7 feet deep at mean low water: 190,000 cubic yards, at 21 cents	$39,900
Dredging to make the basin between harbor lines at the head of the west branch 7 feet deep at mean low water: 150,000 cubic yards, at 28 cents	42,000
Dredging to make the channel in the east branch 9 feet deep at mean low water, 100 feet wide to the steamboat wharf, a distance of about 8,535 feet, and 50 feet wide for 1,200 feet farther: 160,000 cubic yards, at 16 cents	25,600
Contingencies, inspection, etc., estimated at	16,000
Total estimated cost of project of 1892 from beginning	123,500

July 1, 1893, the channel of the west branch, dredged under the completed project of 1883, was in fair condition, the only shoals of less than 5 feet depth being in places where the side banks had fallen in. Under the project of 1892, up to the same date, 20,877 cubic yards of sand and mud had been dredged from the east branch, making a channel 9 feet deep at mean low water and 60 feet wide up to "Turn-up Rock," a distance of about 1,600 feet, and dredging was in progress.

Harbor lines were established in the west branch of this harbor by action of the Secretary of War, dated February 28, 1890.

A sketch of the entire harbor was printed in the Annual Report of the Chief of Engineers for 1893, p. 956.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1894.

At the beginning of the year dredging was in progress under an offer of the Hartford Dredging Company, to do the work at the rate of 16½ cents per cubic yard. This work was completed October 24, 1893, the dredge having removed 40,629 cubic yards during the fiscal year, of which 34,289 cubic yards were applied to extending the channel of the east branch and 6,340 cubic yards to removing two small shoals in the west branch.

The total amount dredged under this accepted offer of the Hartford Dredging Company was 61,506 cubic yards. The channel of the east branch was made 9 feet deep at mean low water up to Hoyts Dock, a distance of 4,100 feet; thence to the Steamboat Dock there was already over 8 feet depth and the channel was widened about 20 feet on the east bank; above the steamboat dock the channel was made from 40 to 60 feet wide and 8 feet deep. From the west branch two shoals were removed at the bends above and below Cooks Point to restore the depth of 5 feet at mean low water.

Drilling and blasting rocks by hired labor under authority of the Chief of Engineers was resorted to in order to remove from the channel of the east branch several large bowlders and ledges which the dredge was unable to move. Under authority of the Chief of Engineers the dredge was hired at a rate of $9 per hour to remove these blasted rocks and several smaller ones of over one-fourth cubic yard, which could be taken up without blasting. Thirty-five bowlders of over one-fourth cubic yard each were taken up by the dredge alone; they contained in aggregate 26.9 cubic yards and their removal cost $151.35, being an average cost of $5.63 per cubic yard. Sixteen larger rocks were drilled and blasted and subsequently taken up by the dredge, either wholly or to over 9 feet depth; the estimated amount of rock removed was 178 cubic yards in place; the actual amount taken up by the dredge, including small fragments and sand, was 612 cubic yards, scow measurement. The cost of drilling and blasting was $4.04 per cubic yard in place, and the cost of dredging and removing was $4.68.

This work was completed November 8, 1893.

In May, 1894, it was reported that there were certain rocks near the edge of the 60-foot channel, which were dangerous at high tide, it being difficult to keep a boat in so narrow a channel. An examination showed that they could be removed without great expense, and the Chief of Engineers authorized the application on the available funds to this work by hired labor, that method being most economical and advantageous to the Government. Arrangements have been made under which this will be done early in the next fiscal year.

PRESENT CONDITION OF IMPROVEMENT.

The channel of the west branch is 5 feet deep at mean low water and 80 feet wide or more up to within 1,000 feet of its head, for which distance the width is from 50 to 80 feet, as made under the completed project of 1886. The only work done in the west branch under the existing project of 1892 was the removal of two small shoals in 1893.

The channel of the east branch is 60 feet wide and 9 feet deep at mean low water up to Hoyts Dock; thence to the Steamboat Dock it is 60 feet wide with depths from 8 to 9 feet; thence to the head of navigation it is 40 to 60 feet wide and 8 feet deep.

PROPOSED OPERATIONS.

It is proposed to expend future appropriations in making and maintaining the dredged channels in both branches of this harbor as provided by the existing project. The estimated cost of completion is $108,500, of which about $15,500 is estimated for completion of work upon the east branch and $93,000 for completion of the work contemplated in the west branch.

Appropriations for improving Stamford Harbor, Connecticut, have been made as follows:

Application.	Date.	Amount.
Survey	Mar. 2, 1829	$100
Do	Aug. 2, 1882	350
Dredging, west branch	Aug. 5, 1886	10,000
Do	Aug. 11, 1888	5,000
Do	Sep. 19, 1890	5,000
Dredging, east branch ... $13,800 Dredging, west branch ... $1,200	July 13, 1892	*15,000
Total		35,450

* The only appropriation made under the existing project of 1892.

Stamford Harbor is in the Fairfield collection district, of which Bridgeport is the port of entry. There is a light-house on the middle ground at the harbor entrance. The nearest work of defense is Fort Schuyler, Throgs Neck, 20 miles to the southwest.

Money statement.

July 1, 1893, balance unexpended	$14,094.94
June 30, 1894, amount expended during fiscal year	13,368.65
July 1, 1894, balance unexpended	726.29
Amount (estimated) required for completion of existing project	108,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	50,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1893.

FOR THE WEST BRANCH.

[Through courtesy of Mr. W. D. Smith, Stamford, Conn.]

Arrivals and departures of vessels.

[Draft 4 to 15 feet; tonnage 10 to 450 tons.]

Kind of vessels.	Number of round trips.
Steamers	180
Sailing vessels	400
Barges	200
Total	780

Aggregate tonnage of all trips not ascertained.

Freight received and shipped by water.

Chief articles.	Tons.	Estimated value.
Receipts:		
Coal	22,000	$110,000
Lumber and baryta	23,000	45,000
Miscellaneous	16,000	140,000
Total	61,000	295,000
Shipments—none reported.		

No new line of transportation has been established since July 1, 1893.
"As everywhere else, business was below the average last year."

FOR THE EAST BRANCH.

[Through courtesy of Messrs. Getman & Judd, Stamford, Conn.]

Arrivals and departures of vessels.

[Draft, 5 to 13 feet; tonnage, 40 to 613 tons.]

Kind of vessels.	Number of round trips.
Steamers	1,325
Sailing vessels	81
Barges	178
Total	1,584

Aggregate tonnage of all trips not ascertained.

Freight received and shipped by water.

Chief articles.	Tons.	Estimated value.
Receipts:		
Coal and wood	54,126	$228,201.00
Lumber and building materials	12,952	121,279.46
Miscellaneous (not otherwise included)	73,728	4,748,993.00
Total receipts	140,806	5,098,473.46
Shipments, miscellaneous	31,533	1,193,120.35

No new lines of transportation have been established since July 1, 1893.

The total amount of freight reported for the West Branch (61,000 tons) is 93,607 tons less than reported for 1892.

The total amount reported for the East Branch (172,339 tons) is 17,732 tons greater than reported for 1892.

D 16.

IMPROVEMENT OF HARBOR AT COS COB AND MIANUS RIVER, CONNECTICUT.

This harbor is a tidal inlet extending about 2 miles northwardly from Long Island Sound at a point 4 miles east of the New York State line. It has a high-water width of from 800 to 2,000 feet, but the low-water channel is narrow and bounded by mud flats. At low tide there is an available depth of 7 feet, with width of about 200 feet for the first half mile, the depth above gradually decreasing to almost zero at the head of the harbor.

Mianus is a small settlement at the north end of the inlet; about three-quarters of a mile below, the stream is crossed by the drawbridge of the New York, New Haven and Hartford Railroad, which has stations known as Riverside and Cos Cob, on the east and west banks, respectively. The commerce of the harbor is practically confined to the supplies of the communities living along its shores. At Cos Cob, above the railroad bridge, is a shipyard, where a considerable number of small boats are repaired and some built; at Riverside, below the bridge, are the houses and docks of the Riverside Yacht Club.

The mean rise of tide is about 7½ feet.

PROJECT FOR IMPROVEMENT.

By act of Congress approved September 19, 1890, a preliminary examination and survey of this harbor were ordered. The report on the survey, dated July 31, 1891, and printed in the Annual Report of the Chief of Engineers for 1891, Part I, p. 855, contains plan and estimates for improvement, to make by dredging a channel of 6 feet depth at mean low water, 150 feet wide up to the railroad bridge, and 100 feet wide thence to Mianus, at cost, as follows:

Dredging 160,000 cubic yards, at 20 cents	$32,000
Contingencies	4,000
Total	36,000

This project was adopted by approval of the Secretary of War, dated July 21, 1892, after the first appropriation for the improvement had been made.

Up to July 1, 1893, 23,953 cubic yards had been dredged from the channel making it 7 feet deep at mean low water up to the railroad bridge, with widths of 75 to 100 feet, under a contract not quite completed.

A sketch of this harbor was printed in the Annual Report of the Chief of Engineers for 1893, p. 958.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1894.

At the beginning of the year dredging was in progress under a contract with Alonzo J. Beardsley, dated October 10, 1892, for dredging ing about 40,000 cubic yards of material at 15 cents per cubic yard. Work was continued until August 7, when the contract was completed. The amount dredged during the fiscal year was 16,047 cubic yards.

The total amount dredged under the contract was 40,000 cubic yards of material, nearly all mud. The channel from the 6-foot curve to the railroad bridge was completed, being made the full width of 150 feet. The depth actually made was from 7 to 7½ feet, to allow for filling in from the adjacent flats which are of very soft mud.

PRESENT CONDITION OF IMPROVEMENT.

The channel is 150 feet wide and 6 feet deep up to the railroad bridge, the work above described being the first Government improvement made in this river.

PROPOSED OPERATIONS.

With future appropriations it is proposed to continue dredging in accordance with the approved project.

The only appropriation made for this improvement is that of $7,000, made by the river and harbor act of July 13, 1892, expended as above described.

Cos Cob Harbor and Mianus River are in the collection district of Fairfield, Conn., of which Bridgeport is the port of entry. The nearest light-house is on Great Captains Island, about 2 miles southwest from the harbor entrance. Fort Schuyler, Throgs Neck, New York, 18 miles to the southwest, is the nearest work of defense.

Money statement.

July 1, 1893, balance unexpended	$6,558.56
June 30, 1894, amount expended during fiscal year	6,141.03
July 1, 1894, balance unexpended	417.53

Amount (estimated) required for completion of existing project	$29,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	20,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893

Abstract of contract for improving harbor at Cos Cob and Mianus River, Connecticut, in force during the fiscal year ending June 30, 1894.

Name and address of contractor.	Date of contract.	Subject of contract.	Price per cubic yard.	Remarks.
Alonzo J. Beardsley, Bridgeport, Conn.	Oct. 10, 1892.	Dredging	$0.15	Contract completed August 7, 1893; amount removed, 40,000 cubic yards.

COMMERCIAL STATISTICS FOR CALENDAR YEAR 1893.

Commercial statistics have been asked for, but up to date of this report have not been received.

D 17.

IMPROVEMENT OF PORT CHESTER HARBOR, NEW YORK.

This harbor consists of the lower part of the Byram River and a bay at its mouth opening into Long Island Sound. The river, for about 1½ miles from its mouth, forms the boundary line between the States of New York and Connecticut. It was formerly navigable to within a few hundred feet of the bridge at Port Chester, a little more than a mile above the mouth.

Before improvement the available depth up to the wharves was about 1 foot at mean low water.

The mean rise of tide is 7.4 feet.

PROJECTS FOR IMPROVEMENT.

A survey of the harbor was made in 1871, and a project for improvement, based on it, was submitted and adopted. The project provided for the removal of two rocks—Sunken Rock, at the entrance to the bay, with 5.7 feet low-water depth, to be removed to 11 feet, and Salt Rock, about 1,000 feet above the mouth of the river, partly bare at low water, to be removed to 9 feet depth; it also provided for a breakwater 400 feet long at Byram Point. The estimated cost was as follows:

Sunken Rock, 1,474.5 cubic yards, at $40	$58,980
Salt Rock, 316.3 cubic yards, $40	12,652
Breakwater at Byram Point	25,000
Total	96,632

Under this project Salt Rock was removed in 1873. No further work was done until 1884, when a survey of the channel was made under the appropriation of August 2, 1882, and a project for expending the funds available in 1884 (about $16,000) was submitted and approved. It provided for making a channel from 60 to 100 feet wide and 2½ feet deep at mean low water from the bay to the vicinity of the bridge at

Port Chester. The channel was completed to within 150 feet of the bridge in May, 1885.

In 1886, 9,232 cubic yards of sand and gravel were dredged, straightening the channel and removing small lumps and irregularities. Under the appropriation of $5,000, made in 1888, the project was modified to omit the removal of Sunken Rock and to change the location of the proposed breakwater, making it extend from Sunken Rock toward the shore. Sunken Rock was dangerous only because it was submerged, and was at the side of the channel; the channel width at the rock was ample. A breakwater, with the end on the rock rising some distance above high water, would serve as a beacon, and would be an aid instead of a danger to navigation, besides affording more shelter than the originally proposed breakwater; thus it would take the place both of the breakwater and of the removal of Sunken Rock, together estimated to cost $83,980. On account of this modification, in the Annual Report of the Chief of Engineers for 1890, the estimated cost for completion of project was reduced from $64,632 to $25,000.

Up to July 1, 1893, Salt Rock had been removed, a channel 2½ feet deep at mean low water had been dredged up to the Port Chester Highway bridge, and the breakwater between Byram Point and Sunken Rock had been built to a length of 783 feet, but not to full cross section.

A sketch of Port Chester Harbor from Salt Rock to Long Island Sound was printed in the Annual Report of the Chief of Engineers for 1889, p. 716.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1894.

At the beginning of the year work was in progress under a contract with Humphrey Toomey, dated October 7, 1892, for extending and enlarging the breakwater at Byram Point, by furnishing and placing about 3,500 tons of riprap, at the rate of $1.24 per ton. Work was continued until August 5, when the contract was completed. During the fiscal year 1,529 tons of stone were placed, of which 452 tons were used in building 72 linear feet of shoreward extension of the breakwater and 1,077 tons were used in enlarging work previously built.

The total amount of stone delivered under the contract was 3,514 tons; the breakwater was extended shoreward to high-water mark on the rocks on Byram Point, building 270 linear feet of wall, and 578 linear feet of the previously built work was enlarged.

At a point 110 feet from the shore end a gap 30 feet wide at bottom was left in the wall, to allow small boats to pass through at high water; the bottom at this point runs bare at low tide.

PRESENT CONDITION OF IMPROVEMENT.

Salt Rock has been removed to a depth of 9 feet at mean low water. The breakwater has been built from Sunken Rock to high-water mark on the rocks at Byram Point; its total length on top is 855 feet, the length over all, including the gap and end slopes, being about 900 feet.

An available channel of 2½ feet depth at mean low water has been dredged to a point 150 feet below the bridge; thence to the bridge the width is 25 feet. In front of the wharves, where vessels lie aground at low tide, the bottom has been leveled as nearly as practicable.

PROPOSED OPERATIONS.

With future appropriations it is proposed to complete the breakwater on Byram Point and to maintain, and if necessary to enlarge, the river channel.

Appropriations for improving Port Chester Harbor, New York, have been made as follows:

Application.	Date.	Amount.
Removing Salt Rock	June 10, 1872	$12,000
Dredging in Byram River and Bay	Aug. 2, 1882	15,000
Breakwater	Aug. 11, 1888	5,000
Do	Sept. 19, 1890	5,000
Do	July 13, 1892	5,000
Total		42,000

Port Chester Harbor is in the collection district of New York.

The nearest light-house is on Great Captains Island, 1¾ miles east of the mouth of the harbor.

The nearest work of defense is Fort Schuyler, Throgs Neck, about 15 miles southwest.

Money statement.

July 1, 1893, balance unexpended	$4,327.24
June 30, 1894, amount expended during fiscal year	4,102.98
July 1, 1894, balance unexpended	224.26
Amount (estimated) required for completion of existing project	15,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	15,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

Abstract of contract for improving Port Chester Harbor, New York, in force during the fiscal year ending June 30, 1894.

Name and address of contractor.	Date of contract.	Subject of contract.	Price per gross ton riprap delivered and placed.	Remarks.
Humphrey Toomey, Guilford, Conn.	Oct. 7, 1892	Delivering and placing riprap and extending and enlarging breakwater.	$1.24	Contract completed Aug. 5, 1893; 3,514 tons of riprap delivered and placed in the breakwater.

COMMERCIAL STATISTICS FOR CALENDAR YEAR 1893.

Arrivals and departures of vessels.

[Draft, 5 to 10 feet; tonnage, 25 to 400 tons.]

Kind of vessels.	Number of round trips.	Aggregate tonnage of all trips.
Steamers	575	58,500
Sailing vessels	390	28,000
Barges	410	130,000
Total	1,375	216,500

Freight received and shipped by water.

Chief articles.	Tons.	Estimated value.
Receipts:		
Coal, iron, lumber, stone, builders' material	99,000	$715,000
Miscellaneous (not otherwise included)	37,000	975,000
Total receipts	136,000	1,690,000
Shipments:		
Farm produce, manufacturers' goods	19,000	900,000
Miscellaneous (not otherwise included)	8,000	125,000
Total shipments	27,000	1,025,000

The above figures show a total tonnage of freight of 163,000 tons, being a decrease of 8,000 tons since the last report received (1892), when 171,000 tons were reported. The difference as stated is due to the general business depression during the past year.

No new line of transportation has been established since July 1, 1893.

D 18.

IMPROVEMENT OF LARCHMONT HARBOR, NEW YORK.

Larchmont Harbor is a bay on the northwest shore of Long Island Sound, about 25 miles by water from the Battery, New York City, and 6 miles southwest from the boundary between the States of New York and Connecticut. The harbor is about half a mile wide, and extends rather more than half a mile inland. It is a basin with no definite channel, the low-water depth of 18 feet at the entrance gradually decreasing toward the shores, east, north, and west.

The harbor is chiefly used by the Larchmont Yacht Club, but is more or less sought by small coasters and fishing vessels for refuge or for night anchorage. It is exposed to storms from east to south, and during northeast storms heavy seas roll around Long Beach Point, east of the harbor, and compel vessels to go well up into shoal water for shelter.

The entrance is divided into three channels by two rocks: Umbrella Rock, about 800 feet from the west shore, being a large ledge with least depth of 3.1 feet at mean low water, and Huron Rock, about 900 feet southwest from the east shore, a smaller ledge with least depth of 9.8 feet. The channel between the rocks is over 900 feet wide, and is the one almost invariably used. There are other rocks inside the harbor which are well known and are marked by spindles; they are too near the west shore to interfere with the use of the harbor for general navigation.

The mean rise of tide is 7.4 feet.

PROJECTS FOR IMPROVEMENT.

The river and harbor act of August 11, 1888, provided for a survey of Larchmont Harbor, which was made the following year. The report on the survey, dated November 26, 1889, was printed as House Ex. Doc. No. 40, Fifty-first Congress, first session, and also in the Annual Report of the Chief of Engineers for 1890, Part I, p. 675. With the report were presented two alternative projects for improvement, one for removal of Umbrella and Huron rocks, the other for breakwaters to cover each rock and extend to the nearest shore. The cost of removing the rocks to 15 feet depth at mean low water was estimated at $126,000, and the cost of the two breakwaters at $105,000. At the date of the report the preference of those most interested in the harbor was expressed in favor of removing the rocks. After further consideration they changed their views, preferring the breakwaters, and, in accordance with their petition or request, a clause in the first draft of the river and harbor act of 1890, which required that the money appropriated for the harbor be expended "to remove obstructions at mouth of harbor," was struck out.

The project for constructing two breakwaters at the mouth of the harbor was approved by the Secretary of War September 27, 1890, after the first appropriation for improving the harbor was made.

Up to July 1, 1893, 74 linear feet of Umbrella Breakwater and 64 linear feet of Huron Breakwater had been built.

A sketch of Larchmont Harbor was printed in House Ex. Doc. No. 40, Fifty-first Congress, first session, in connection with the report upon survey, but no sketch of the harbor has been printed with Annual Report of the Chief of Engineers.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1894.

Nothing was done.

PRESENT CONDITION OF IMPROVEMENT.

The only public work done in this harbor is the beginning of construction of two breakwaters. Umbrella Breakwater has been made 74 feet long and Huron Breakwater 64 feet long. Both were begun upon the rocks and were built to 10 feet above low water, with top width of 4 feet, the outer ends being slightly higher to serve as beacons on the rocks. At their present lengths they serve no other purpose than to mark the rocks.

PROPOSED OPERATIONS.

Future appropriations should be applied to complete both breakwaters, as provided for in the project.

The only appropriation for improving Larchmont Harbor, New York, is the one of $5,000 made by the act of Congress approved September 19, 1890.

Larchmont Harbor is in the collection district of New York. The nearest lighthouse is on Execution Rock, 3 miles southward. Fort Schuyler, about 8 miles southwest, is the nearest work of defense.

Money statement.

July 1, 1893, balance unexpended	$120.95
July 1, 1894, balance unexpended	120.95
Amount (estimated) required for completion of existing project	100,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	50,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

COMMERCIAL STATISTICS FOR CALENDAR YEAR 1893.

Commercial statistics have been asked for, but up to date of this report have not been received.

D 19.

IMPROVEMENT OF EAST CHESTER CREEK, NEW YORK.

East Chester Creek, called also Hutchinson River, is a small stream which, as a tidal inlet for the last 4 miles of its course, traverses marshes of one-quarter to 1 mile in width, and empties into East Chester or Pelham Bay, a large bay on the northwest shore of Long Island Sound, just east of Throgs Neck, and 20 miles by water from the Battery, New York City. The width of the creek varies from 25 feet to half a mile at high water, but the channel is narrow everywhere.

Pelham bridge, a highway bridge, crosses the creek near its mouth. A short distance above is the bridge and trestle of the Harlem River branch of the New York, New Haven and Hartford Railroad, and at Lockwood, about 2¼ miles above its mouth, the stream is crossed by the Boston road. All three bridges are drawbridges.

The mean rise of tide at the mouth of the creek is 7.1 feet.

For half a mile up the creek there was originally a channel from 4 to 9 feet deep at low water, but the depth decreased farther up, and at Town Dock, the principal landing, about 1½ miles from the mouth, the available depth at high water was only about equal to the rise of the tide. Above Town Dock the stream was narrow and crooked, and the depth about the same as just below.

The commerce at Town Dock was principally in coal and building materials for East Chester and Mount Vernon; the latter is a rapidly growing place, with a present population of about 15,000. The main business part of the city of Mount Vernon is about 2 miles from Town Dock. It is understood to be mainly for the benefit of prospective Mount Vernon commerce that the improvement of East Chester Creek is desired.

PROJECTS FOR IMPROVEMENT.

In 1871 a survey of East Chester Creek was ordered by Congress. It was made in the same year, and in the report, dated January 19, 1872, and printed in the Annual Report of the Chief of Engineers for 1872, p. 812, three plans of improvement were outlined, viz:

For making and maintaining, by means of a tidal basin and a system of dikes, a channel 9 feet deep at mean low water, estimated to cost $1,646,000.

For making and maintaining in the same way a channel 11 feet deep at mean high water (about 4 feet at low water), estimated to cost $731,000.

For securing 7 feet depth at slack-water navigation by means of a lock above Goose Island (about half a mile from the mouth of the creek), estimated to cost $300,000.

No recommendation as to the worthiness of improvement accompanied these estimates. March 25, 1872, the House of Representatives passed a resolution inquiring the cost of removing obstructions between tide gauges No. 1 and No. 2, so as "to afford the same depth of water above Station No. 1 as now prevails below it."

In reply to this resolution, a report was submitted April 3, 1872 (see Annual Report of the Chief of Engineers for 1872, p. 814), containing the following estimates:

Basin, purchase of site, 18 acres, at $150	$2,700
Excavation to level of mean low water, 200,000 cubic yards, at 40 cents	80,000
Excavation of cut, 60,000 cubic yards, at 40 cents	24,000
Diking and revetting banks of cut	12,000
Engineering and contingencies	17,805
Total	136,505

This plan contemplated (as appears from maps on file) straightening the channel at Lockwood and, as it was necessary in any case to replace the old arch bridge of the Boston road by a drawbridge, changing the location of such bridge to a point about 700 feet eastward, so as to give a straighter and cheaper channel for the stream.

In 1873 $25,000 was appropriated for improving East Chester Creek. It was designed to expend it in accordance with the above estimates, which were then considered an adopted project, but no means had been provided for acquiring the land needed for the proposed cut at Lockwood, so no work was done at that time.

In 1875 it became apparent that the proposed change of location of the drawbridge at Lockwood could not be made. The old bridge lay on the boundary between the towns of East Chester and Pelham and was supported by the towns jointly. Under the proposed change of location the new bridge would lie within the town of Pelham, which town would then have to support it; therefore the town of Pelham would not consent to the change, and the old bridge was replaced by an iron drawbridge in the same location. The proposed location of the cut had, therefore, to be altered to bring it to the drawbridge. This necessitated excavating a considerable amount of rock at an increased cost of $10,000. (See General Newton's letter to the Chief of Engineers, September 24, 1875.)

In 1875 $12,000 more was appropriated for this improvement, but it was not until 1877 that a commission, appointed by the State of New York, finally obtained the land for the proposed cut. After this right of way was secured, in 1877, a contract was entered into for making a cut 9 feet deep at mean high water (2 feet at low water), with a width of 100 feet at high-water level; this contract included about 3,149 cubic yards of rock excavation, 1,210 linear feet of pile dike, and 140 linear feet of crib dike. It was completed in 1878, and in that year and in 1879, under an appropriation of $10,000 made June 18, 1878, dredging was done by hired labor, removing a shoal of bowlders just outside of Pelham bridge, and making a channel about 125 feet wide and 9 feet deep at high water on the west side of Goose Island, being an extension of the original project.

In 1879 $3,500 was appropriated for continuing the improvement, and $3,500 in 1880. These appropriations were not expended until 1884.

In the Annual Report for 1879 it was stated as necessary to complete the improvement from Pelham bridge to Lockwood "to construct dikes from the lower end of the cut to Goose Island, a distance of 5,800 feet." In 1880 these dikes were estimated to cost $40,000.

The appropriations were not large enough to warrant beginning the cut above Lockwood, or the above-mentioned dikes, and these proposed works were apparently abandoned for the time being. In 1881 General Newton, U. S. Engineers, then in charge, reported that—

> Furthermore, until it is proved that a depth of 9 or 10 feet * * * can not be maintained under the scale of improvement already completed, it will be unnecessary to inaugurate new works. The amount of funds available, $7,372.14, will be quite sufficient for the present wants of the case.

This money was expended in 1884 in dredging just below Town Dock, a work not included in the original estimate.

August 5, 1886, $10,000 was appropriated for this improvement, which was mostly expended in 1888 and 1889 in dredging between Town Dock and Lockwood to remove shoals from the previously dredged channel.

In 1887 an estimate was made of the cost of the several proposed extensions of project, from which it appears that $81,000 have been either expended or estimated for works not included in the first estimate, and that estimate, therefore, should be increased to $221,000 if it is proposed to carry out the original plan with these extensions.

It was proposed to expend the appropriation of $5,030, made August 11, 1888, in dredging a cut above Lockwood, and in January, 1889, the line of cut was staked out and a description given to the State commissioners for securing right of way. They were asked to obtain permission to deposit the material on the marsh lands adjacent to the cut, which could be done cheaply as compared with the cost of carrying it out into Long Island Sound. The commissioners reported that this consent could not be obtained, and as the available funds were not sufficient to begin work under any other plan for disposing of dredged materials, work was postponed until larger appropriations should be made.

In 1892, owing to certain changes of ownership, it was found that the requisite permission to deposit dredgings on the banks of the creek could be secured, and by authority of the Chief of Engineers an offer of the Mount Vernon Suburban Land Company to dredge and deposit material upon adjacent banks at the rate of 22 cents per cubic yard, prism measurement, was accepted. Under this offer 27,700 cubic yards of mud were dredged and deposited on the west side of the cut, making a channel 9 feet deep at high water, 60 feet wide at bottom, with side slopes of 1 upon 1, extending northward 1,300 feet above the Lockwood drawbridge.

A sketch of East Chester Creek was printed in the Annual Report of the Chief of Engineers for 1893, p. 968.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1894.

No work was done by the United States. Private parties dredged a slip into the marshes of the west bank just above Lockwood, and have utilized the dredged channels by establishing a propeller freight line, making regular trips three times per week between Mount Vernon and New York City.

PRESENT CONDITION OF IMPROVEMENT.

There is a channel of 9 feet depth at mean high water (2 feet at low water) from the bay to a point 1,300 feet above Lockwood, with a width of 100 feet or over to a point 1,000 feet above Town Dock; thence to Lockwood from 50 to 75 feet wide, and above Lockwood 60 feet wide.

The dikes on the east side of the channel below Lockwood are in fair condition.

PROPOSED OPERATIONS.

With future appropriations it is proposed to widen the channel below Lockwood and to widen and deepen it above Lockwood, as provided in the modified project. The estimated cost of this work, as submitted in the Annual Report for 1891, is $55,000.

The dikes below Town Dock, at one time proposed, do not seem to be necessary at present as a means of improving or maintaining the channel.

Appropriations for improving East Chester Creek have been made as follows:

Application.	Date.	Amount.
Cutting through marsh and rock, and diking (in 1877)	Mar. 3, 1873	$25,000
Dredging under Boston road bridge and at Goose Island	Mar. 3, 1875	12,000
Dredging near Lockwood, Goose Island, and Pelham bridge	June 18, 1878	10,000
Dredging from 40 to 90 feet wide from Pell Point to Town Dock	Mar. 3, 1879 June 14, 1880	3,500 3,500
Dredging above Town Dock	Aug. 5, 1886	10,000
Dredging above Lockwood	Aug. 11, 1888	5,000
Total		69,000

East Chester Creek is in the collection district of New York.

The nearest light-house is on the "Stepping Stones," 3 miles southeast of the mouth of the creek.

The nearest work of defense is Fort Schuyler, Throgs Neck, about 3½ miles south.

Money statement.

July 1, 1893, balance unexpended	$15.33
June 30, 1894, amount expended during fiscal year	15.33
Amount (estimated) required for completion of existing project	55,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	55,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1893.

Arrivals and departures of vessels.

[Draft, 5 to 7 feet; tonnage, 150 to 200 tons.]

Kind of vessels.	Number of round trips.
Steamers	168
Sailing vessels	4
Barges	164
Total	336

Aggregate tonnage of all trips not ascertained.

Freight received and shipped by water.

Chief articles.	Tons.	Estimated value.
Receipts:		
Lumber	1,000	$20,000
Building materials	17,490	94,360
Coal	10,500	52,500
Miscellaneous (not otherwise included)	27,000	145,000
Total receipts	55,990	311,860

Shipments: None reported.

The above figures show an increase of tonnage over that reported for 1892 (the last received) of 8,875 tons.

Since July 1, 1893, a freight steamer line has been established, making triweekly trips between New York City and Lockwoods.

The year 1893 was a fair average year for commerce by water, but with the improvement of the river the commerce will very greatly increase.

JOHN E. BRYANT.

MOUNT VERNON, N. Y., *May 7, 1894.*

D 20.

IMPROVEMENT OF GREENPORT HARBOR, NEW YORK.

This harbor is a roadstead near the east end of the north fork of Long Island, lying between the north fork on the northwest and north, and Shelter Island on the southeast and south. The anchorage ground was exposed to storms from northeast and east.

A sand spit, called Joshua Point, formerly protected the little bay at Greenport from easterly storms, but in a few years prior to 1883 this had worn away rapidly and the sand had been carried into the bay.

The mean rise of tide is 2.4 feet.

PROJECT FOR IMPROVEMENT.

The river and harbor act of 1881 ordered a survey of this harbor, the report upon which, dated January 20, 1882, and printed in the Annual Report of the Chief of Engineers for 1882, Part I, p. 635, contained plans and estimates for a breakwater (extending to the curve of 18 feet depth) to be built to 3 feet above mean high water level, with a top width of 5 feet and side slopes of 1 upon 1; the estimated cost was $46,000. The first appropriation for the harbor was made by act of Congress of August 2, 1882, and, thereupon the project was adopted as above. In 1890 the project was modified to provide for building up the breakwater to a height of 5 feet above mean high water, to extend it no farther (it was then 1,570 feet long), and to apply the remainder of the estimate for completion of improvement to dredging in the anchorage afforded by the breakwater.

Up to July 1, 1893, the breakwater had been built up to the required dimensions, and 22,441 cubic yards of sand had been dredged, enlarging the anchorage area of 9 feet depth inside the breakwater by about 3 acres, and making a channel 40 feet wide and 6 feet deep at mean low water to afford an entrance to Sterling Basin, a landlocked cove much used for winter anchorage for yachts and small vessels.

Harbor lines were established in Greenport Harbor by the Secretary of War, January 5, 1894.

A sketch of Greenport Harbor was printed in the Annual Report of the Chief of Engineers for 1893, p. 970.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1894.

At the beginning of the year dredging was in progress under a contract with P. J. Brummelkamp, dated October 12, 1892, for removing about 45,000 cubic yards of material at 20 cents per cubic yard. Work was continued under an extension of the contract until September 15, 1893, when the contract was completed.

The amount dredged during the fiscal year was 32,820 cubic yards, increasing the anchorage area of 9 feet depth inside the breakwater by about 2 acres, and widening and deepening the entrance to Sterling Basin.

The total amount dredged under the contract was 43,224 cubic yards. This work completed the project for improvement of the harbor.

PRESENT CONDITION OF IMPROVEMENT.

The breakwater is 1,570 feet long, 5 feet wide on top, the top being 5 feet above high water; it contains 19,310 tons of riprap.

The available anchorage of 9 feet depth inside the breakwater has been increased by 5 acres of completely sheltered area. The channel between Sterling Basin and the outer harbor has been made 60 feet wide and 8 feet deep at mean low water.

PROPOSED OPERATIONS.

The amount of the original estimate for this improvement has been appropriated and expended, and the projected improvement has been completed. Nothing further is now contemplated.

Appropriations for improving Greenport Harbor have been made as follows:

Application.	Date.	Amount.
Survey	Mar. 3, 1881	$500
Expended on breakwater	Aug. 2, 1882	10,000
Do	July 5, 1884	10,000
Do	Aug. 5, 1886	5,000
Do	Aug. 11, 1888	5,000
Breakwater and dredging	Sept. 19, 1890	5,000
Dredging	July 13, 1892	11,000
Total		46,500

Greenport is a port of delivery, in the collection district of Sag Harbor.

The nearest light-house is on Long Beach Point, 3 miles to the eastward.

The nearest work of defense is Fort Trumbull, New London Harbor, Connecticut, 21 miles distant in a straight line.

Money statement.

July 1, 1893, balance unexpended	$9,840.48
June 30, 1894, amount expended during fiscal year	8,544.71
July 1, 1894, balance unexpended	1,295.77

Abstract of contract for improving Greenport Harbor, New York, in force during the fiscal year ending June 30, 1894.

Name and address of contractor.	Date of contract.	Subject of contract.	Price per cubic yard.	Remarks.
P. J. Brummelkamp, Syracuse, N. Y.	Oct. 12, 1892	Dredging	$0.20	Contract completed under extension Sept. 15, 1893. Total amount dredged, 43,224 cubic yards.

COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1893.

[Through courtesy of S. Truman Preston, Greenport, N. Y.]

Arrivals and departures of vessels.

[Draft 3 to 18 feet; tonnage 5 to 1,200 tons.]

Kind of vessels.	Number of vessels.	Number of round trips.
Steamers	34	About 2,700
Sailing vessels	191	
Yachts	300	
Total	525	

Aggregate tonnage of all trips not ascertained.

Freight received and shipped by water.

Chief articles.	Tons.	Estimated value.
Receipts:		
Coal	12,000	$60,000
Fish and fertilizers	89,704	Unknown.
Miscellaneous (not otherwise included)	20,276	Unknown.
Total receipts	121,980	
Shipments:		
Brick	20,000	$140,000
Miscellaneous (not otherwise included)	16,330	Unknown.
Total shipments	36,330	

Number of vessels built in 1893, 12 small sail boats.
Number of vessels repaired in 1893, 325, from 5 to 400 tons.
Number of vessels entered for refuge in 1893, 525 (estimated).
No new lines of transportation have been established since July 1, 1893.

The last previous statement of commerce for Greenport Harbor was for 1890, when 43,500 tons of freight were reported.

D 21.

IMPROVEMENT OF PORT JEFFERSON HARBOR, NEW YORK.

Port Jefferson Harbor is on the north shore of Long Island and about 50 miles east from New York city. It is a mile long and averages three-quarters of a mile wide, and a large part of the area has a depth of 18 feet or more at low tide. Tributary to this harbor, on the west, are Setauket Harbor and Conscience Bay, two shallow tidal basins. Port Jefferson Harbor is surrounded on three sides by hills, and is separated from Long Island Sound on the north by a beach of sand and gravel, through which, and nearly in the axis of the harbor, is a single entrance 400 feet wide. This entrance is Port Jefferson Inlet, and through it a tidal reservoir of 2 square-miles area receives and discharges some 300,000,000 cubic feet of water with every tide, producing a current whose maximum velocity exceeds 4 miles per hour. In the narrow part of the inlet the depths have always been considerable, but a short distance out into the sound was a broad, flat bar, which originally had a depth of 4 feet at low water; until the beginning of Government improvement in 1871 the location of the inlet had been shifting; since 1838 it had moved westward 790 feet, an average annual rate of 24 feet.

The village of Port Jefferson, with a population of about 3,000, lies at the head or south end of the harbor. The mean rise of tides at the village wharves is 6.2 feet; in Long Island Sound, outside the inlet, it is 7 feet. The difference is wholly in the low-water levels.

PROJECTS FOR IMPROVEMENT.

A survey of the harbor was made in 1853 by Lieutenant Harrison, U. S. Engineers. In 1870 an examination was ordered by Congress. The first project for improvement was submitted by General Warren, January 16, 1871, after an examination, and provided for building a jetty on the east side of the entrance, extending out to the 9 foot curve and rising to 11 feet above mean low water, to be built partly of dimension stone; also for dredging a channel 200 feet wide and 7 feet deep at mean low water through the bar. (See Annual Report of the Chief of Engineers for 1871, p. 805.) The estimated cost was as follows:

Construction of jetty	$150,125
Dredging	15,000
Total	165,125

When the project was adopted under the appropriation of March 3, 1871, it was provided that the jetty should be of riprap, rising only to the level of mean high water, except between the high and low water marks on the beach, where it was to be carried to the level of the highest tides, but no change was made in the estimates. Under this appropriation 600 feet of the jetty were built, and under the appropriation of June 10, 1872, it was extended to 1,052 feet. An estimate made in 1873 of the cost of completion ($35,000) made the estimate for the whole project $65,000. In 1875 a modification of the project, based on the observed effect of the jetty, was made, providing for a jetty on the west side of the entrance about 1,075 feet long and rising 4 feet above mean high water, designed to increase the force of the tidal currents. The width of the channel was also reduced to 100 feet. No new estimate was submitted at the time, but in 1877, after about $8,000 had been expended on the west jetty, it was estimated that $12,250 would be required to complete it, or $20,250 in all. A revised estimate, made in the same year for the whole improvement, contemplated extending the east jetty to the 9-foot curve, extending the west jetty 600 feet farther, and dredging a channel 100 feet wide and 8 feet deep (this increase of depth on account of increased draft of vessels using the harbor), at an estimated cost of $34,000. Forty-five thousand dollars had then been appropriated and nearly expended, making the total estimate from the beginning $79,000 (including $6,000 appropriated in 1876 and then unexpended). This estimate was incorrectly reported in 1878, but was reverted to in 1879 and repeated in each subsequent annual report. In 1877 one cut 25 feet wide and 8 feet deep was dredged through the bar. The channel was dredged to a width of 100 feet under the apropriation of March 3, 1879. In 1877 the east jetty was raised to a height of 5 feet above mean high water and extended 50 feet. In 1878 the west jetty was extended 450 feet, but the height was made only 2 feet above mean low water, except the outer end and an intermediate point, which were raised to 4 feet above mean high water, to serve as guides.

Between 1879 and 1883 both jetties were extended and repaired, making their respective lengths 1,390 feet for the east jetty and 940 feet for the west jetty. This completed the then existing project.

By act of Congress of August 11, 1888, an examination of Port Jefferson Inlet was ordered. A preliminary examination was found sufficient, with recent Coast Survey charts, for all required purposes, and with the report on this examination, dated December 5, 1888, and printed in the Annual Report of the Chief of Engineers for 1889, part 1, p. 751, were presented plans and estimates for making and maintaining channels through the inlet of 10 and 12 feet depth, respectively. The 10-foot channel was considered by interested parties as sufficient for present needs. The estimates in detail were as follows:

For a channel 10 feet deep and 200 feet wide:

Repairing and enlarging east jetty	$34,200
Repairing and enlarging west jetty	18,150
Dredging	25,390
Contingencies, say	12,260
Total	90,000

Commencement of work under this project for 10 feet depth was approved by the Secretary of War November 1, 1890, after an appropriation had been made for "the project to give a channel 10 feet deep and 200 feet wide."

Up to July 1, 1893, the east jetty had been enlarged for its whole length outside high-water mark, and about 250 linear feet of the west jetty, at its outer end, had been enlarged; dredging upon the 10-foot channel was in progress, and up to that date it had been made 40 feet wide.

A sketch of Port Jefferson Inlet, the entrance to the harbor, was printed in the Annual Report of the Chief of Engineers for 1886, p. 660.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1894.

At the beginning of the year dredging was in progress under a contract with John H. Fenner, dated February 6, 1893, providing for removal of about 50,000 cubic yards of material at the rate of 32½ cents per cubic yard. This work was continued until October 6, when the contract was completed. The amount dredged during the fiscal year was 36,838 cubic yards. The channel through the inlet was widened 200 feet, making it 10 feet deep at mean low water.

The total amount dredged under this contract was 49,987 cubic yards; the cuts began in 1892 were completed, and the channel was made 240 feet wide and 10 feet deep from the 10-foot curve inside to the 10-foot curve outside the shoal; distances varying from 1,000 to 1,800 feet in the different cuts.

PRESENT CONDITION OF IMPROVEMENT.

The east jetty is 1,390 feet long, part of the shore end being covered by drifting sand; it is 6 feet above high-water level, and 4 feet wide on top. The west jetty is 940 feet long; the outer 250 feet are built up about 4 feet above high water, with top width of 4 feet; the inner part is about 2 feet above low water. The west jetty requires building up, and both require trimming and filling out the side slopes before they can fairly be considered completed.

The dredged channel has been made 240 feet wide and 10 feet deep at mean low water through the inlet.

PROPOSED OPERATIONS.

Future appropriations will be applied to completing the jetties and widening the channel, as provided for in the approved project.

Appropriations for Port Jefferson Harbor have been made as follows:

Application.	Date.	Amount.
East jetty	Mar. 3, 1871	$15,000
Do	June 10, 1872	15,000
East and west jetties	Mar. 3, 1875	15,000
East jetty and dredging	Aug. 14, 1876	6,000
East and west jetties	June 18, 1878	8,000
Dredging	Mar. 3, 1879	5,000
East and west jetties	June 14, 1880	3,000
East jetty	Mar. 3, 1881	4,000
Do	Aug. 2, 1882	8,000
Enlarging jetties and dredging	Sept. 19, 1890	25,000
Dredging	July 13, 1892	10,000
Total		114,000

Port Jefferson is a port of delivery in the collection district of New York. There is a light-house on Old Field Point, 1¼ miles west of the harbor entrance. Fort Hale, New Haven Harbor, Connecticut, 23 miles distant, is the nearest work of defense.

Money statement.

July 1, 1893, balance unexpended	$18, 216. 78
June 30, 1894, amount expended during fiscal year	17, 017. 77
July 1, 1894, balance unexpended	1, 199. 01
Amount (estimated) required for completion of existing project	55, 000. 00
Amount that can be profitably expended in fiscal year ending June 30, 1896	35, 000. 00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

Abstract of contract for improving harbor at Port Jefferson Inlet, New York, in force during the fiscal year ending June 30, 1894.

Name and address of contractor.	Date of contract.	Subject.	Price per cubic yard.	Remarks.
John H. Fenner, Jersey City, N. J.	Feb. 6, 1893	Dredging	$0. 32½	Contract completed Oct. 6, 1893; total amount dredged, 49,987 cubic yards.

COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1893.

[Through courtesy of J. T. Mather, Port Jefferson, N. Y.]

Arrivals and departures of vessels.

[Draft, 3 to 9 feet; tonnage, 15 to 704 tons.]

Kind of vessels.	Number of round trips.	Aggregate tonnage of all trips.
Steamers	650	45, 500
Sailing vessels	700	28, 800
Barges	22	2, 640
Total	1, 372	76, 940

Freight received and shipped by water.

Chief articles.	Tons.	Estimated value.
Receipts: Building materials, coal, grain, rubber-factory goods, and general merchandise	33, 000	$995, 000
Shipments: Wood, farm produce, flour, feed, rubber goods, shellfish, etc	13, 000	137, 000

The above figures show a decrease in tonnage of freight of 1,000 tons since 1892, when 47,000 tons were reported.

No new lines of transportation have been established since July 1, 1893.

Vessels built during 1893 (of 20 tons)	1
Vessels entered harbor for refuge	300
Vessels hauled up for repair (ranging from 15 to 704 tons)	185
Tonnage of vessels hauled up for repair ... tons	11, 000
Vessels laid up for winter 1893–'94	82
Tonnage of vessels laid up for winter 1893–'94 ... tons	5, 740

D 22.

IMPROVEMENT OF HUNTINGTON HARBOR, NEW YORK.

Huntington Harbor is a landlocked basin about 2 miles long and a quarter of a mile wide, extending in a crooked but generally southern direction from Huntington Bay, from which it is separated by a beach of sand and gravel, through the western end of which a narrow inlet (about 300 feet wide) connects the harbor and bay.

The bay is a large, deep harbor of refuge on the north shore of Long Island, about 40 miles east from New York City. The harbor has an available depth of about 8 feet at mean low water through the entrance and more than half-way up, but in the three-quarters of a mile nearest the head or south end of the harbor the original channel was narrow and decreasing in depth to zero at low tide.

Huntington village lies about a mile south of the head of the harbor; it has 4,000 to 5,000 population.

The mean rise of tide is 7.2 feet.

PROJECTS FOR IMPROVEMENT.

By act of Congress approved March 3, 1871, a survey of this harbor was authorized. It was made in that year, and, with the report (dated December 11, 1871, and printed in the Annual Report of the Chief of Engineers for 1872, p. 907), was submitted an estimate of $22,780 as the cost of dredging out a shoal at the entrance to the harbor, and of extending the 8-foot channel 150 feet wide for about 2,000 feet up to the old wharf, the property of the town.

By act of Congress of June 10, 1872, $22,500 was appropriated for the harbor, and the project for improvement was completed in April, 1873, the outer shoal being removed to 8 feet depth and the 8-foot channel being extended 2,200 feet to the old town wharf; the width of 150 feet was, however, reduced to 130 feet in the last 900 feet length, on account of exhaustion of funds. It had been contemplated to dump most of the dredged material on the flats in the harbor, but on account of much local opposition this was abandoned after about 2,000 yards had been dumped there, and the rest of the dredged material was deposited in deep water in Long Island Sound. The amount dredged was 91,786 cubic yards.

The river and harbor act of July 5, 1884, ordered a survey or examination of this harbor. A survey was made the same year, the report of which (printed in the Annual Report of the Chief of Engineers for 1885, p. 703, *et seq.*) contains a plan for restoring and maintaining the depth of 8 feet, made by dredging in 1872 and 1873, but subsequently lost by settling of the banks, with estimate of cost for carrying the channel up to the old town dock, as follows:

Dredging 84,000 cubic yards, at 25 cents per cubic yard	$21,000
Pile protection, 1,400 linear feet, at $5 per linear foot	7,000
	28,000
Superintendence and contingencies	4,000
Total	32,000

with an estimate of additional cost of $10,000, should it be decided to carry the channel up to the last wharf on the east side, a distance of 800 feet farther.

The beginning of work under this project was approved by the Secretary of War, November 3, 1890, after an appropriation for the improvement had been made by Congress.

Up to July 1, 1893, the 8-foot channel had been dredged 105 feet wide up to the bend at and near Old Town Wharf, with width of 185 feet at the bend and with 90 feet width above the bend nearly to the upper landing of the harbor. No work had been done on the projected pile protection.

A sketch of the upper part of Huntington Harbor was printed in the Annual Report of the Chief of Engineers for 1893, p. 976.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1894.

Nothing was done.

PRESENT CONDITION OF IMPROVEMENT.

The channel is now 105 feet wide up to the bend at and near Old Town Wharf, 185 feet wide at the bend, and about 90 feet wide above the bend nearly to the upper landing in the harbor; the channel is in good condition. No work has been done on the projected pile protection.

PROPOSED OPERATIONS.

It is proposed to apply future appropriations to completing the channel and to maintaining it by further dredging or by diking, as seems expedient.

Appropriations for improving Huntington Harbor have been made as follows:

Application.	Date.	Amount.
Dredging	June 10, 1872	$22,500
Do	Sept. 19, 1890	10,000
Do	July 13, 1892	5,000
Total		$37,500

Huntington Harbor is in the New York collection district.

The nearest light-house is on Eaton Point, at the east side of the mouth of Huntington Bay, about 4 miles distant from the harbor.

The nearest works of defense are the fortifications at Willets Point, about 20 miles westward.

Money statement.

July 1, 1893, balance unexpended	$397.49
June 30, 1894, amount expended during fiscal year	187.50
July 1, 1894, balance unexpended	209.99
Amount (estimated) required for completion of existing project	17,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	10,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1893.

Arrivals and departures of vessels.

[Draft, 4 to 9 feet; tonnage, 50 to 450 tons.]

Kind of vessels.	Number of round trips.	Aggregate tonnage of all trips.
Steamers	195	78,000
Sailing vessels	450	85,000
Barges	14	6,000
Total	659	169,000

Freight received and shipped by water.

Chief articles.	Tons (estimated)	Estimated value.
Receipts	32,000	$660,000
Shipments	14,000	285,000

The above figures show an increase in tonnage of freight of 2,000 tons since 1892, when 44,000 tons were reported.

No new lines of transportation have been reported since July 1, 1893.

The year 1893 was about an average year for commerce, but, if anything, there was a slight increase, notwithstanding a general business depression. The above are mostly estimates, no official shipping list being kept. Our people all agree that the appropriations have been well expended. The additional width given to the channel greatly increases its usefulness. There seems to be little, if any, shoaling of the channel where excavated, which would indicate that much diking or piling would be inexpedient. Additional width is most important. Additional appropriations are earnestly hoped for, so that the work may be completed according to the Engineers' recommendations.

CHARLES R. STREET,
Chairman, Huntington Harbor Improvement Committee.

MAY 1, 1894.

D 23.

IMPROVEMENT OF GLEN COVE HARBOR, NEW YORK.

Glen Cove Harbor is a small estuary or creek opening into the east side of Hempstead Bay, Long Island, about 1¾ miles from Long Island Sound and about 27 miles by water from the Battery, New York City. The channel in the creek is about 2 feet deep at mean low water, and a bar at the entrance has a foot less depth. Vessels entering Glen Cove Harbor have to wait for high tide, anchoring in Hempstead Bay, where they are exposed to storms from the north and northwest. When such storms are heavy it is impossible to tow over the bar, and from this cause vessels have been obliged to remain in the bay for three or four days exposed to heavy seas.

The mean rise of tide in this harbor is 7.7 feet.

PROJECT FOR IMPROVEMENT.

The act of Congress, approved August 5, 1886, provided for a survey or examination of Glen Cove Harbor. A preliminary examination was all that was deemed necessary, and upon this, with the assistance of the U. S. Coast Survey charts recently published, a report with estimates of cost of improvements was presented, dated December 7, 1886, and printed in the Annual Report of the Chief of Engineers for 1887, Part I, p. 645.

The plan of improvement described in this report contemplated a breakwater about 2,500 feet long and extending in a general westerly direction from Mosquito Point on the east side of Hempstead Bay and north of the entrance of Glen Cove Inlet, the breakwater to be built of riprap, the top to be 5 feet wide and 3 feet above high water, with side slopes of 1 upon 1, at an estimated cost as follows:

136,000 tons of riprap, at $1.35 per ton	$183,600
Contingencies, 10 per cent	18,360
Total	201,960

This project was adopted in 1888, an appropriation being made by Congress for beginning the work, and the location of the shore end of the breakwater was definitely fixed to be at the northwest corner of the Glen Cove Dock and its course to be west-southwesterly toward Mott Point.

Up to July 1, 1893, 1,056 linear feet of the breakwater had been built, 1,000 feet of which was 3 feet wide on top, with the top 4 feet above high water, the outer 56 feet being 3 feet wide on top at 1 foot above high water. A contract for enlarging and extending the breakwater was in progress.

A sketch of part of Hempstead Bay, showing Glen Cove Harbor improvement, was printed in the Annual Report of the Chief of Engineers for 1889, p. 728.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1894.

At the beginning of the year, work of enlarging and extending the breakwater was in progress under a contract with Brown & Fleming, dated October 4, 1892, for delivering and placing about 13,000 tons of riprap at 69 cents per ton. This work was continued until August 9, 1893, when the contract was completed.

During the fiscal year 3,300 tons of riprap were delivered and placed, enlarging the outer 56 linear feet of the work to 3 feet top width at 4 feet above high water and extending the breakwater 20 feet, with the same cross section. At the extreme outer end the work was built 3 feet higher to serve as a temporary beacon.

Under the entire contract 11,550 tons of riprap were delivered, of which 9,900 tons were used in enlarging the previously built work (1,056 feet in length) and 1,650 tons were used in extending the breakwater 20 feet.

PRESENT CONDITION OF IMPROVEMENT.

The breakwater is now 1,076 feet long on top, the top being 3 feet wide and 4 feet above mean high water, the extreme outer or western end being built 3 feet higher to serve as a temporary beacon.

PROPOSED OPERATIONS.

Future appropriations should be applied to further extending the breakwater, as provided by the approved project.

Appropriations for improving Glen Cove Harbor, New York, have been made as follows:

Application.	Date.	Amount.
Breakwater	Aug. 11, 1888	$20,000
Do	Sept. 19, 1890	15,000
Do	July 13, 1892	10,000
Total		45,000

Glen Cove Harbor is in the collection district of New York; the nearest light-house is on Sands Point, about 4 miles west; Fort Schuyler, New York Harbor, is the nearest work of defense.

Money statement.

July 1, 1893, balance unexpended	$6,795.05
June 30, 1894, amount expended during fiscal year	6,562.82
July 1, 1894, balance unexpended	232.23
July 1, 1894, outstanding liabilities	16.00
July 1, 1894, balance available	216.23
Amount (estimated) required for completion of existing project	156,960.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	50,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

Abstract of contract for improving Glen Cove Harbor, New York, in force during the fiscal year ending June 30, 1894.

Name and address of contractor.	Date of contract.	Subject of contract.	Price per ton, riprap.	Remarks.
Brown & Fleming, New York City.	Oct. 4, 1892	Delivery of riprap and enlargement and extension of breakwater.	$0.69	Contract completed Aug. 9, 1893; amount of riprap delivered, 11,550 tons.

COMMERCIAL STATISTICS FOR CALENDAR YEAR 1893.

Arrivals and departures of vessels.

[Draft, 4½ to 9½ feet; tonnage, 35 to 280 tons.]

Kind of vessels.	Number of round trips.	Aggregate tonnage of all trips.
Steamers	520	182,000
Sailing vessels	104	10,400
Barges	500	225,000
Total	1,124	417,400

Freight received and shipped by water.

Chief articles.	Tons.	Estimated value.
Receipts: Corn, coal, lumber, merchandise, and miscellaneous articles	160,000	$2,225,000
Shipments: Starch, glucose, corn, feed, fire clay, garden and farm products, oysters, fish	145,000	3,800,000

The above figures show an increase in tonnage of freight of 3,571 tons since 1889, the last year when such statistics were received.

Vessels built during 1893 (5 merchant vessels and 21 yachts)	26
Vessels repaired in 1893 (ranging from 15 to 125 tons)	50
Vessels anchored behind the breakwater for shelter during 1893	1,500

No new lines of transportation have been established since July 1, 1893.

LETTER OF MR. S. D. PHELPS.

THE NATIONAL STARCH MANUFACTURING CO.,
No. 1 Broadway, New York, April 19, 1894.

SIR: I inclose herewith an estimate of the commerce of Glen Cove Harbor, New York, for the current year 1893. The statement is merely an estimate, because no official records are kept from which to obtain exact data.

The breakwater as far as completed has been of undoubted benefit, not only as to the permanency and depth of the channel, but also in making the harbor more secure for vessels in fogs and heavy weather. During the year upon different occasions more than a hundred vessels at a time sought shelter from storms behind the breakwater.

During seven or eight months of the year two steamers, one for passengers and the other for freight, make daily trips to and from New York. A large amount of freight traffic is also done by sailing vessels, barges, and canal boats.

There are three ship yards in the harbor for the building and repair of vessels.

Yours, respectfully,

S. D. PHELPS.

Col. HENRY M. ROBERT,
Engineer Office, U. S. A.

D 24.

IMPROVEMENT OF FLUSHING BAY, NEW YORK.

Flushing Bay is on the north shore of Long Island, about 14 miles by water from the Battery, New York City. The town of Flushing is on the east bank of Flushing Creek, just above the head of the bay. The bay is about 1 mile wide and 2 miles long. The bottom is of soft mud, nearly level, the depth in the original channel being not much greater than elsewhere. In 1861 a depth of 5 feet at low water was reported in the channel leading up to Flushing. At the beginning of the improvement by the United States the depth there was but 3.9 feet. The mean rise of tide is 7.1 feet.

PROJECTS FOR IMPROVEMENT.

A survey of Flushing Bay was made in 1878, and a project for improvement based upon the survey was proposed and adopted. This project provided for constructing two dikes, the first to extend northerly from the head (or south end) of the bay along the west side of the channel; then, bending to continue westward to Herrick Point, at the west side of the mouth of the bay, thus forming a large tidal basin, which should fill and discharge through the main channel; the second to start from a point near the middle of the east shore and extend northwardly to the 6-foot curve, confining the channel. It also provided for dredging to make and maintain a channel 6 feet deep at mean low water. The estimated cost of this work was as follows:

Constructing 4,400 linear feet of pile dike, at $10 per foot	$44,000
Constructing 7,800 linear feet of pile dike, at $9 per foot	70,200
Constructing 900 linear feet of pile dike, at $7.50 per foot	6,750
Constructing 3,600 linear feet of single piling, at $3.70 per foot	13,320
For 83,000 cubic yards of dredging, at 20 cents per cubic yard	16,600
Contingencies	22,630
Total	173,500

All the timber work of the dike was to be creosoted.

The first appropriation was expended in building 3,057 linear feet of pile dike on the west side of the channel, extending northward from near the head of the bay. Subsequent appropriations until 1888 were expended in dredging to make and maintain the required channel depth, it being found necessary to dredge repeatedly in the same places. The total amount of material dredged in this period was about 235,000 cubic yards.

In September, 1888, a modification of the original project was approved, which provided for "extending the dike northward and toward the west side of the channel at College Point, and for dredging, omitting the dikes running westerly to Herrick Point, and the single row of piles on the east side." In 1891, owing to strong opposition to the dike by a large number of property owners at Flushing, College Point, and Newtown, further work upon it was discontinued, and the project was modified to provide for maintaining the channel by dredging only.

Up to July 1, 1893, 4,663 linear feet of the dike had been built. The channel, which has been dredged repeatedly, had fully the required depth of 6 feet at mean low water, with width of 70 to 100 feet.

A sketch of Flushing Bay was printed in the Annual Report of the Chief of Engineers for 1889, p. 732.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1894.

Nothing was done.

PRESENT CONDITION OF IMPROVEMENT.

The dike, 4,663 linear feet long, is in poor condition; the outer part of it, 1,606 feet long, which was left partly completed in 1891, has since then been much damaged by storms and ice. Further work upon the dike being discontinued, owing to strong opposition of property owners along the shores of the bay (see Annual Report of the Chief of Engineers for 1892, Part I, p. 723), it is not proposed to repair this damage. A small light at the outer (north) end of the dike, maintained by the Light-House Department, prevents the structure in its present condition being a serious menace to navigation of the bay.

The channel is now fully 6 feet deep at mean low water, with widths from 70 to 100 feet.

PROPOSED OPERATIONS.

The required depth and nearly the full width having been secured, the further work desired under the project consists principally in maintaining the channel.

Appropriations for improving Flushing Bay have been made as follows:

Application.	Date.	Amount.
Construction of dike	Mar. 3, 1879	$20,000
Dredging	June 14, 1880	15,000
Do	Mar. 3, 1881	10,000
Do	Aug. 2, 1882	5,000
Do	July 5, 1884	10,000
Do	Aug. 5, 1886	10,000
Construction of dike and dredging	Aug. 11, 1888	15,000
Repair of dike and dredging	Sept. 19, 1890	20,000
Dredging	July 13, 1892	10,000
Total		115,000

Flushing Bay is in the collection district of New York. The nearest light-house is on North Brother Island, 3 miles to the northwest. There is a small light on the north end of the dike in the bay, maintained by the Light-House Department. Fort Schuyler and Willets Point, about 4 miles east from the mouth of the bay, are the nearest works of defense.

Money statement.

July 1, 1893, balance unexpended	$5,019.02
June 30, 1894, amount expended during fiscal year	4,427.77
July 1, 1894, balance unexpended	591.25
Amount (estimated) required for completion of existing project	58,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	20,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

COMMERCIAL STATISTICS FOR CALENDAR YEAR 1893.

These statistics have been asked for but have not been received, the only returns being for the freight of Boyer's Flushing and College Point Line; the boats of the line made 304 round trips, the aggregate tonnage of all trips being 20,330 tons.

No records of harbor commerce are kept at Flushing, and no complete or satisfactory estimates of amounts can be obtained.

For the calendar year 1888, 2,440 vessels were reported arriving and departing, with 229,235 tons of freight.

No new lines of transportation have been established since July 1, 1893.

D 25.

IMPROVEMENT OF PATCHOGUE RIVER, NEW YORK.

Patchogue River is a small stream on the south side of Long Island, emptying into Great South Bay, near its eastern end, and about 55 miles in a direct line east from New York City. The village of Patchogue, which lies about a mile north of the mouth of the river, has a resident population of about 5,000, which is considerably increased during the summer months.

The approach to Patchogue River by water is through Fire Island Inlet, and thence by a rather crooked course for some 14 miles through Great South Bay; the depth through the bay and up to within a half mile of the river's mouth is about 8 feet; at the mouth of the river the natural depth shoaled up to about 2 feet, which depth could be carried up to the village landings.

About the year 1870 the State of New York made an appropriation for improving the entrance to this river. A jetty about 1,000 feet long was built from the west side of the mouth of the river and a channel dredged alongside of it. The jetty was built of a single row of sheet piling, with round piles at intervals of 6 feet, and riprapped along the sides. In 1891 about 200 linear feet of the piling remained, but badly injured; the riprap could be traced for nearly the whole length of the work, but no trace of the dredged channel remained.

The mean rise of the tide at Patchogue River is 1.1 feet.

PROJECTS FOR IMPROVEMENT.

The river and harbor act of June 4, 1880, provided for a survey of the river, which was made that year; the report dated October 30, 1880, and printed in the Annual Report of the Chief of Engineers for 1881, p. 674, contained estimates for a plan of improvement as follows:

The estimate to secure a depth of 6 feet at mean low water by dredging in the river, and from its mouth to the 6-foot curve in the bay is	$21,000
For diking, from river to 6-foot curve in bay	15,800
Engineering, contingencies, etc., 15 per cent	5,520
Total	42,320

One dike was to be on the west side of the river's mouth, and another and shorter one on the east side; the total length of the two to be about 2,400 feet, to be of carbolized timber filled with riprap, and to be from 5 to 7 feet wide from out to out.

Nothing had been done toward the desired improvement, and in 1886, another examination (ordered by the river and harbor act of that year) was made.

The report on this examination is printed in the Annual Report of the Chief of Engineers for 1887, p. 759. This report contained a project and estimate for dredging a channel 60 feet wide and 6 feet deep from the Highway bridge at Patchogue (4,000 feet above the mouth of the river) to the 6-foot curve in Great South Bay, a total length of about a mile, and to protect the channel in the bay by a dike or jetty on its west side 1,700 feet long. The plan also mentioned the possible necessity of a dike on the east side, but it was not included in the estimates, which were as follows:

Dredging from the head of navigation at the bridge to the 6-foot contour in Great South Bay, the channel being 60 feet wide and 6 feet deep, would require the removal, by scow measurement, of about 60,000 cubic yards of sand, at 30 cents per cubic yard	$18,000
Diking, 1,700 linear feet, at $10 per linear foot	17,000
Superintendence, contingencies, etc	5,000
Total	40,000

Beginning of work under this project was approved by the Secretary of War October 4, 1890, after the first appropriation for the improvement had been made.

Up to July 1, 1893, the jetty had been built 1,340 feet long, terminating in 4½ feet depth of water; the top was 1 foot above high water and 3 feet wide. The dredged channel had been extended to Gilberts Point, about 1,200 feet inside the mouth of the river, with width of 60 to 150 feet and depths from 6 to 12 feet, some private dredging having been done to considerable depths, to obtain material for filling on marsh lands. The channel outside the mouth of the river has shoaled somewhat since it was dredged in 1890.

Harbor lines for Patchogue River were established by the Secretary of War under date of January 17, 1894.

A sketch of Patchogue River was printed in the Annual Report of the Chief of Engineers for 1893, p. 984.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1894.

No work of improvement was in progress, the funds appropriated being practically exhausted.

An examination of the harbor was made and a plan and description of harbor lines were prepared and reported upon, which were established by approval of the Secretary of War, January 17, 1894.

PRESENT CONDITION OF IMPROVEMENT.

The channel from Great South Bay to the mouth of the river, dredged 50 feet wide and 6 feet deep in 1891, has shoaled so that the available depth is now scant 5 feet at mean low water; above the entrance, to Gilberts Point, the depth is fully 6 feet and width from 60 to 150 feet, partly dredged at private expense. Above Gilberts Point the available depth to the head of the stream is 3½ feet, though it is considerably deeper in places, the result of private dredging.

The jetty is in fair condition; it was damaged slightly by ice during the winter of 1892-'93, but not so as to urgently need repair.

PROPOSED OPERATIONS.

Future appropriations should be applied to completing the dredged channel and extending the jetty.

Appropriations for improving Patchogue River, New York, have been made as follows:

Application.	Date.	Amount.
Constructing jetty and dredging	Sept. 19, 1890	$15,000
Dredging	July 13, 1892	8,000
Total		23,000

Patchogue River is in the collection district of New York. The nearest lighthouse is at Fire Island Inlet, 14 miles southwest. The nearest work of defense is Fort Hale, New Haven Harbor, Connecticut, about 35 miles in a direct line northward.

Money statement.

July 1, 1893, balance unexpended	$4,180.17
June 30, 1894, amount expended during fiscal year	3,585.97
July 1, 1894, balance unexpended	594.20
Amount (estimated) required for completion of existing project	17,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	17,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1893.

[Through courtesy of Messrs. E. Bailey & Sons, Patchogue, N. Y.]

Arrivals and departures of vessels.

[Draft, 4 to 9 feet; tonnage, 8 to 500 tons.]

Kinds of vessels.	Number of round trips.	Aggregate tonnage of all trips.
Steamers	100	45,000
Sailing vessels	800	50,000
Barges	300	30,000
Total	1,200	125,000

Freight received and shipped by water.

Chief articles.	Tons.	Estimated value.
Receipts: Lumber, coal, brick, stone, oysters, and general merchandise	100,000	$1,350,000
Shipments: Lumber, oysters, etc	25,000	350,000
Total receipts and shipments	125,000	1,700,000

These figures show an increase of 5,000 tons over amount of freight reported for 1892.

Vessels built during 1893, ranging from 8 to 50 tons	30
Vessels repaired during 1893, ranging from 8 to 300 tons	150

No new lines of transportation have been established since July 1, 1893.

The year 1893 was not a fair average year, owing to general business depression. Improvement made is a great advantage to navigation, and will greatly increase receipts and shipments by water when completed. The above figures are estimated only, but fairly accurate.

D 26.

IMPROVEMENT OF BROWNS CREEK, SAYVILLE, LONG ISLAND, NEW YORK.

Browns Creek is a small stream flowing midway between the villages of Sayville and Bayport, near the south shore of Long Island, and emptying into Great South Bay about 11 miles northeast of Fire Island Inlet. From Fire Island Inlet to the vicinity of Browns Creek there is a rather crooked channel of 8 feet available depth. The original entrance to the creek was crooked, narrow, and shifting. Its depth at mean low water was about 0.4 foot. In the stream itself the low-water level was from 0.3 to 1.3 feet higher than low water in Great South Bay, and the channel depths from zero to 3 feet below low water in the bay. The width of the stream from the bay to the Highway Bridge, about 5,000 feet, averages 77 feet. Its course lies through a marsh from one-quarter to one-half mile in width, separated from the bay by a low and narrow beach. In its natural condition this stream was not available for any purpose of navigation.

The permanent population of Sayville is said to be 3,500.

The mean rise of tide in Great South Bay is 1.1 feet; at the Highway bridge, except in dry seasons, it is scarcely noticeable.

PROJECT OF IMPROVEMENT.

In pursuance of the river and harbor act of August 11, 1888, a survey of Browns Creek was made, the report on which was printed in House Ex. Doc. No. 22, Fifty-first Congress, first session; and also in the Annual Report of the Chief of Engineers for 1890, Part I, pp. 669–674. With this report plans and estimates for work were presented as follows:

> The object of the desired improvements is to secure an anchorage ground or place where the fishing boats can lie in safety during rough weather. This can be accomplished by widening and deepening the creek and improving its mouth. To prevent the entrance from filling up by drift and wave action, jetties will probably be needed on both sides, certainly on the west side, as the drift of sand along the shore is from west to east. The jetties should be of riprap, the top and slopes to be of stone weighing not less than one-fourth ton, the top to be 3 feet wide and 1 foot above high water, with slopes of 1 on 1. The stone on the top and slopes should be

selected and carefully laid, so as to present as smooth a surface as possible, to resist the action of the moving ice.

The cost of dredging a channel 100 feet wide and 6 feet deep at mean low water from the 6-foot curve in the bay up to the first bend in the creek (1,850 feet) is estimated to be:

33,000 cubic yards, at 30 cents per cubic yard, the material to be deposited in the bay	$9,900
For a 4-foot channel 100 feet wide above this point to the Highway bridge, 4,680 feet, 86,000 cubic yards, at 11 cents per cubic yard, the material to be placed on the banks	12,040
Cost of west jetty, 1,600 feet long, 3,700 cubic yards of riprap, at $2.50 per cubic yard	9,250
Cost of east jetty, 1,400 feet long, 3,100 cubic yards of riprap, at $2.50 per cubic yard	7,750
Contingencies	7,060
Total	46,000

The first work to be done should be the deepening at and near the mouth, and the construction of jetties, commencing at the shore end. These works should be carried on simultaneously.

This improvement would not only benefit those engaged in oystering and fishing, but would enable many articles of commerce to be brought to Sayville by water, instead of by rail, as at present. A partial improvement would be of great benefit to small vessels.

The beginning of work under this project was approved by the Secretary of War October 4, 1890, after the first appropriation for improving Browns Creek had been made.

Up to July 1, 1893, 492 feet of the west jetty and 438 feet of the east jetty had been built to a height of 1 foot above mean high water and the dredged channel had been made 1,893 feet long, 100 feet wide, and 4 feet deep at mean low water.

No sketch of Browns Creek has been printed in any annual report of the Chief of Engineers prior to 1894. A sketch, from the survey, was printed in connection with the report on the survey in House Ex. Doc. No. 22, Fifty-first Congress, first session.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1894.

Nothing was done.

PRESENT CONDITION OF IMPROVEMENT.

The west jetty has been made 492 feet long and the east jetty 438 feet long, both with top width of 3 feet at height of 1 foot above mean high water. Since work on them was suspended, in August, 1892, they have suffered trifling damage from ice, but not such as to require immediate repair; they are in fair condition.

The dredged channel, 1,893 feet long, 100 feet wide, and 4 feet deep at mean low water, has shoaled a few inches from deposit of a very soft mud. About 1,400 feet of this channel lies inside the shore line, and is used freely for night anchorage by small oyster boats owned and operated in the vicinity. Private canals have been dredged into the east bank of the creek by the owners of the property, amounting in aggregate to 1,525 linear feet. This additional area is used both for business purposes and for anchorage.

PROPOSED OPERATIONS.

Future appropriations will be applied to maintaining and extending the channel and to completing the jetties, as contemplated in the approved project.

Appropriations for improving Browns Creek have been made as follows:

Application.	Date.	Amount.
Constructing jetties and dredging	Sept. 19, 1890	$12,000
Dredging	July 13, 1892	5,000
Total		17,000

Browns Creek is in the collection district of New York.

The nearest light-house is at Fire Island Inlet, about 11 miles southwest.

The nearest works of defense are the fortifications at Willets Point, New York, about 35 miles west, and Fort Hale, New Haven Harbor, Connecticut, about the same distance northeastwardly.

Money statement.

July 1, 1893, balance unexpended	$375.83
June 30, 1894, amount expended during fiscal year	175.00
July 1, 1894, balance unexpended	200.83
Amount (estimated) required for completion of existing project	29,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	20,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1893.

Draft of vessels using harbor, feet	2 to 5
Oyster boats and small vessels belonging in harbor, estimated at	260
Amount of oysters taken during the year by vessels belonging in harbor (estimated about), bushels	240,000
Vessels (estimated) using harbor for shelter or for night which could not have used it before improvement, over	240

Largest number of vessels observed at one time in the harbor: No actual count appears to have been made during the past year, but on more than one occasion the harbor has been filled with boats up to its entire capacity, leaving only a passage way in and out.

Vessels built during 1893 (ranging from 7 to 18 tons)	8
Vessels repaired in 1893 (ranging from 5 to 20 tons)	20

No new lines of transportation have been established since July 1, 1893.

Estimated amount of commerce by water, received at Browns Creek: There seems to be no way of even approximately stating the amount of commerce with reasonable certainty, but according to all observations it was nearly doubled, as a continuation of the improvement offered further facilities, and it is regarded as certain that a completion of the work along the lines originally laid out would bring to the harbor practically all the commerce of the vicinity, except such merchandise as from its nature would necessarily have to be carried by rail.

SAYVILLE, LONG ISLAND, N. Y., *April 27, 1894.*

In addition to the foregoing statistics, which are as nearly accurate as it has been possible to make them, it is suggested that I call your attention to the following:

* * * * * * *

The last winter being an open one has demonstrated the great advantage of the improvement as affording a harbor for daily refuge to the oyster boats, which before the improvement was made would have been "laid up" for the winter months at points too far distant to have rendered them accessible for use even when the weather was favorable to the industry.

Very respectfully, yours,

JOSEPH WOOD,

(On behalf of the Village Improvement Society of Sayville and Bayport.)

D 27.

REMOVING SUNKEN VESSELS OR CRAFT OBSTRUCTING OR ENDANGERING NAVIGATION.

1. WRECK IN BLOCK ISLAND SOUND, OFF THE COAST OF RHODE ISLAND.

ENGINEER OFFICE, U. S. ARMY,
New York, N. Y., September 15, 1893.

GENERAL: I have the honor to submit the following report upon examination and removal of a mast attached to a wreck in Block Island Sound:

This mast was reported to the Commissioner of Navigation by Capt. W. S. Schley, U. S. Navy, inspector of Third light-house district, under date of August 5, 1893, and the matter was referred to me by indorsement of the Chief of Engineers, dated August 12, 1893.

The location of this obstruction was S. by W. ½ W. from Quonocontaug Life-Saving Station, Rhode Island, about 2 miles out from shore in Block Island Sound, which is nearly as exposed as the open ocean. This made the examination, to find whether there were other masts standing below the surface, comparatively an expensive matter, while the removal of the single mast would be but slight additional expense; and upon representation of these conditions to the Chief of Engineers, authority was granted to make the examination and, if found practicable, to remove the dangerous part of the wreck, and an allotment of $150, or so much thereof as may be necessary, was made for such work.

Two attempts were made to examine this wreck, which failed, owing to rough seas and difficulty in obtaining a proper vessel; but on these occasions a detailed plan of operations was arranged, which succeeded on the third trial.

On the 5th of September, a tugboat was taken out to the locality. The standing mast was readily found, and a rope about 250 feet long, weighted at different points, was attached to the mast and sunk to a depth of about 30 feet and then slowly swept around in a circle. This would have discovered the other masts, if any had been standing within 25 feet of the surface, but none were found. A hawser was then fastened to the standing mast, and by pulling in different directions with the tug the mast was finally loosened from the wreck and came clear, with boom and gaff attached. The mast removed was about 60 feet in length. If the other masts are still standing in their steps in the deck —the depth being 18 fathoms—they would be from 35 to 40 feet below the surface. At this depth it would be very difficult to find and remove them, and, as long as they remain there, they can not be dangerous to vessels.

The wreckage removed was old and of no value to sell It was towed into New London Harbor and taken ashore.

The mast is supposed to be part of the three-masted schooner *Harry White*, loaded with iron pipe and sunk in that vicinity by collision on or about March 22, 1892. The mast had been wrenched from its step and the heel had floated upward, being held in place by the mast-head stays, so firmly that the exposed mast stood nearly vertical, without regard to the tidal currents.

The only dangerous part of the wreck which a careful examination discovered has been removed to a depth of over 50 feet below the surface; the entire cost of the examination and removal has been $89.52.

Very respectfully, your obedient servant,

HENRY M. ROBERT,
Lieut. Col., Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

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2. WRECK OF SCHOONER ELIZA ANDERSON IN NEW HAVEN HARBOR, CONNECTICUT.

ENGINEER OFFICE, U. S. ARMY,
New York, N. Y., August 9, 1893.

GENERAL: I have the honor to report that the schooner *Eliza Anderson,* coal laden, was sunk in a collision near Faulkners Island, Long Island Sound, some time in June, 1893. The Chapman Wrecking Company raised the wreck about two weeks ago and brought her into New Haven Harbor, to a point about 300 feet east of Sandy Point Dike, where the water is about 6 feet deep at low tide, removed her load, stripped her of everything valuable, and abandoned her. I wrote the wrecking company about this matter on the 1st of August, and received their reply that they did not propose to do anything further to the wreck (copies of letters inclosed, omitted here). In my judgment, the wreck in its present position is a dangerous obstruction to navigation in New Haven Harbor. Small boats sail in this vicinity at all stages of tide, and the large steamers occasionally run as far inshore at high tide.

I consider this "the creation of an obstruction not affirmatively authorized by law," such as is prohibited by section 10 of the river and harbor act, approved September 19, 1890, and recommend that the matter be referred to the Attorney-General of the United States, for institution of proceedings in accordance with the section above referred to.

I inclose herewith, besides the correspondence above mentioned, a sketch showing approximately the location of the wreck and a clipping from the New Haven Palladium of August 8, 1893 (omitted here).

Very respectfully, your obedient servant,

HENRY M. ROBERT,
Lieut. Col., Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

REPORT OF LIEUT. COL. H. M. ROBERT.

ENGINEER OFFICE, U. S. ARMY,
New York, N. Y., September 22, 1893.

GENERAL: I have the honor to submit the following report upon the removal from New Haven Harbor of the wrecked schooner *Eliza Anderson,* taken up from near Faulkners Island by the Chapman Wrecking Company, and left by them in New Haven Harbor in a position where she was a source of danger to navigation.

This action of the wrecking company and their refusal to remove the wreck were reported in my letter to the Chief of Engineers, dated August 9, 1893, with recommendation that the matter be referred to the Department of Justice.

On August 15 I was notified by the Chief of Engineers that this recommendation had been adopted and acted upon, and at the request of Mr. Geo. P. McLean, U. S. attorney for the State of Connecticut, I visited him at his office and conferred with him concerning the details of the action of the wrecking company.

At my request the attorney notified the company of his proposed action and suggested they call on me in reference to the matter.

Subsequently their attorney called on me, and, after examining the law and discussing the case, came a second time with a member of the firm, who explained that they had been wholly ignorant of the requirements of the law, and had not known that they were violating it in making such disposition of the wreck, but that they intended at once to take it up from New Haven Harbor and to sink it in Long Island Sound, in water 15 fathoms depth or over.

On the 3d and 4th of September, 1893, the wreck was taken up and carried out of New Haven Harbor. I had no notice of this and consequently no opportunity to verify the depth of water where it was sunk. The wrecking company report that they sunk it in 15 fathoms depth, the masts and everything above the deck having been removed. I had an examination made of the place where the wreck had lain, and found there one piece of timber, 12 by 18 inches and 16 feet long, which I had removed.

Nothing of the wreck now remains in New Haven Harbor which can be a source of danger to vessels.

Very respectfully, your obedient servant,

HENRY M. ROBERT,
Lieut. Col., Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

3. WRECK OF STEAMER PANTHER IN ATLANTIC OCEAN, OFF SOUTHAMPTON, LONG ISLAND, NEW YORK.

ENGINEER OFFICE, U. S. ARMY,
New York, N. Y., October 17, 1893.

GENERAL: I have the honor to submit the following report upon examination and removal of part of the sunken steamer *Panther*.

This wreck was reported to the Commissioner of Navigation by Capt. W. S. Schley, U. S. Navy, inspector of the Third light-house district, under date of September 1, 1893, and the matter was referred to me by indorsement of the Chief of Engineers dated September 7, 1893 (3817).

The *Panther* was an ocean tug, iron-built, bound east with two barges in tow. She was caught off the south shore of Long Island in the violent storm of August 24, 1893, which carried away her barges and disabled the tug. She came to anchor, but was unable to ride out the gale. She was "swamped," filled, and sunk in 56 feet of water about 2 miles south of the Life-Saving Station at Southampton, Long Island. The barges drifted ashore and were broken up. One of the *Panther's* two masts was also carried ashore. Twenty lives were lost in the wreck.

At the time the wreck was reported the only part above water was a small gaff or derrick, attached by a chain. About 6 feet below water could be seen the cross-trees attached to the masthead, the topmast having gone ashore.

The location out in the open ocean and 50 miles distant from Fire Island Inlet, the nearest shelter, made the examination practically dependent upon securing still water, and it appeared probable that the dangerous parts of the wreck could be removed at the time of the examination and at very little additional expense. Upon representation of these conditions to the Chief of Engineers, authority was granted to make the examination and, if found practicable, to remove the dangerous parts of the wreck at the same time and by hired labor, as being most economical and advantageous to the Government.

A party of three went from this office on October 9, with dynamite, wires, and battery, having the promise of assistance from the life-saving crew at Southampton. On the 10th the surf was running too high to get out, but on the 11th two boats succeeded in passing it. On reaching the wreck it was found that the conditions had changed since it was reported. The derrick was still floating; the mast had broken off close to the deck and was standing about 3 feet out of water, heel up, inclined about 25° from the vertical; the cross-trees were entangled in the rigging below in such a way as to hold the mast very rigid; it was inclined against the tide. A search was made for the smokestack, but it could not be found; presumably it had broken off, but if left standing, it could hardly be a serious danger to vessels.

A sounding line was slid down along the mast, after repeated trials, to a depth of 25 feet; further than this it would not follow the mast but caught in the rigging. A charge of dynamite was sunk on the line and exploded, when the mast came up in a piece 32 feet long with several smaller pieces aggregating 3 to 4 feet; the mast was but about 36 feet long, the deck being 42 feet below water, and the mast when first reported, 6 feet below water; so that this accounted for practically all of the mast, the remaining parts being only the end at the cross-tree, which is sunk by the weight of the iron rigging.

The derrick was a small spar about the size of an ordinary spar-buoy; it was not set free by the first explosion but remained held by a chain to the deck or rigging below. A small charge of dynamite set the derrick free, and derrick and mast were drifted ashore.

The only dangerous parts of the wreck which the examination revealed or which remained on the boat, according to the description of her, were thus removed to a depth of over 30 feet below low water.

I take pleasure in acknowledging indebtedness to Keeper Burnett and the crew of the life-saving station at Southampton, N. Y., for their efficient assistance and cordial cooperation.

The entire cost of the examination including the removal of the dangerous parts of the wreck was $75.83.

Very respectfully, your obedient servant,

HENRY M. ROBERT,
Lieut. Col., Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

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4. WRECK OF SCHOONER LIZZIE RAYMOND IN LONG ISLAND SOUND, NEAR THE WEST END OF LONG SAND SHOAL.

ENGINEER OFFICE, U. S. ARMY,
New York, N. Y., October 24, 1893.

GENERAL: I have the honor to submit the following report upon removal of the wreck of schooner *Lizzie Raymond* near the west end of Long Sand Shoal, Long Island Sound.

This wreck was first brought to my notice while making inquiry about another wreck reported in that part of Long Island Sound, and was reported by me to the Chief of Engineers August 1, 1893, as follows:

> On the night of July 23, 1893, the two-masted schooner *Lizzie Raymond*, of Greenport, N. Y., about 200 tons, Capt. Davis or Davidson, of Port Jefferson, N. Y., bound from Greenport, N. Y., to Port Jefferson with cargo of oyster shells, capsized in a squall and sank in about 12 feet depth at low water at a point near the west end of Long Sand Shoal. The wreck now lies with one gunwale exposed at low tide in a locality where she is a serious danger to vessels of light draft. It is estimated that the cost of removing this wreck would be about $600. In my judgment it ought to be removed, and if the owners can not be induced or required to do it, I respectfully recommend that it be done by the United States, and that the estimated amount required, $600, be allotted for that purpose.

The allotment was made, and under date of August 22, 1893, notice to owners or interested parties was given by publication in newspapers, and advertisement for proposals for removing the wreck was made. The following is an abstract of proposals received:

Abstract of proposals for removing the wreck of the schooner Lizzie Ragmond, lying in Long Island Sound near the west end of Long Sand Shoal, off Westbrook, Conn., received in response to attached advertisement, dated August 22, 1893, and opened September 22, 1893, by Lieut. Col. Henry M. Robert, Corps of Engineers.

No.	Name and address of bidder.	Amount of bid.	Method of removal.	Remarks.
1.	Charles W. Johnston and Enoch Townsend, Somers Point, N. J.	$745	In pieces by means of explosives.	Lowest bid.
2.	Chapman Derrick and Wrecking Company, 70 South street, New York City.	773	Remove the wreck intact.	

NOTE.—Amount available for work, about $600.

By direction of the Chief of Engineers, the bid of Charles W. Johnston and Enoch Townsend was accepted, and an additional allotment of $250 was made for the work.

When the contractors were ready to begin work, October 10, 1893, it was found that the position of the wreck had shifted from the crest of the shoal to the south side, and from a depth of 12 feet to a depth of about 30 feet at mean low water, these depths being about 125 feet apart in that locality. The hulk was completely buried in sand, nothing but the masts, bowsprit, and a small part of the forward rail being above the level of the surrounding bottom. The contractors exploded 224 pounds of dynamite in 8 charges upon the wreck with the result of shattering into splinters all of the wreck which could be found above the level of the surrounding bottom.

The work of removal was begun on October 12, and completed the following day.

Very respectfully, your obedient servant,

HENRY M. ROBERT,
Lieut. Col., Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

The total amount expended during the year on the removal of wrecks is $922.10.

D 28.

ESTABLISHMENT OF HARBOR LINES IN GREENPORT HARBOR, NEW YORK.

HOUSE OF REPRESENTATIVES, UNITED STATES,
Washington, D. C., August 30, 1893.

SIR: I beg to inclose the within letter from the Hon. H. A. Reeves, of Greenport, Suffolk County, N. Y., and to ask that the request therein made may, if possible, be complied with, viz, that a harbor line be established in and for Greenport Harbor.

With great regard, your obedient servant,

JAMES W. COVERT,
Representative First New York District.

The SECRETARY OF WAR.

[Second Indorsement.]

OFFICE CHIEF OF ENGINEERS,
U. S. ARMY,
September 1, 1893.

Respectfully referred to Lieut. Col. Henry M. Robert, Corps of Engineers, for report.

If, in his opinion, harbor lines should be established at Greenport, under section 12 of the river and harbor act of August 11, 1888, as amended and reenacted by the river and harbor act of September 19, 1890, Lieutenant Colonel Robert is requested to submit a map and description showing the location of the lines recommended for approval.

H. M. ADAMS,
Acting Chief of Engineers.

[Third indorsement.]

ENGINEER OFFICE, U. S. ARMY,
New York, December 23, 1893.

Respectfully returned to the Chief of Engineers, U. S. Army, with report of this date.

H. M. ROBERT,
Lieut. Col., Corps of Engineers.

[Fourth indorsement.]

OFFICE CHIEF OF ENGINEERS,
U. S. ARMY,
December 27, 1893.

Respectfully returned to the Secretary of War.

This is an application for the establishment by the Secretary of War of harbor lines for Greenport Harbor, Long Island, New York, under the provisions of section 12 of the act of Congress of September 19, 1890.

The subject has been under consideration by Lieut. Col. Henry M. Robert, Corps of Engineers, whose report, dated the 23d instant, is herewith, to which attention is respectfully invited.

Col. Robert recommends the establishment of the harbor lines shown in red on the accompanying tracing,* and described in a paper herewith marked A. These lines, it is stated, meet with general approval from the citizens of Greenport, and are in the interest of harbor preservation. A portion of the lines extends over a sand spit, partly above high water, which is private property. The owner of this property has consented to the lines, however, and has conveyed to the United States by a formal instrument the right to lay out the same across the sand spit, and subsequently to dredge and remove the earth up to such lines.

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* Omitted.

I recommend approval of the lines indicated by Col. Robert.

THOS. LINCOLN CASEY,
Brig. Gen., Chief of Engineers.

[Fifth indorsement.]

WAR DEPARTMENT, *January 5, 1894.*

The location of harbor lines for Greenport Harbor, Long Island, New York, is approved.

DANIEL S. LAMONT,
Secretary of War.

LETTER OF MR. H. A. REEVES.

GREENPORT, *August 28, 1893.*

FRIEND COVERT: At the instance of the trustees and other leading citizens I write to ask that you speak to the Secretary of War on behalf of having a harbor line established in and for Greenport Harbor. Messrs. Robert and Babcock, of the U. S. Engineer Corps, when here the other day, remarked upon the importance of this being done as soon as practicable. The harbor grows yearly in importance as a resort for all classes of vessels, and it is high time a harbor line was established for the protection of channels.

* * * * * * *

Yours,

H. A. REEVES.

REPORT OF LIEUT. COL. HENRY M. ROBERT, CORPS OF ENGINEERS.

ENGINEER OFFICE, U. S. ARMY,
New York, N. Y., December 23, 1893.

GENERAL: In compliance with second indorsement, dated Office Chief of Engineers, U. S. Army, September 1, 1893, upon letter of August 30, 1893, from Hon. James W. Covert to the Secretary of War, I have the honor to submit the following report.

In the upper part of Greenport Harbor, where the natural channel becomes narrow, docks have already been built which encroach upon the available waterway more than is desirable. This is apparent upon examining the map of the harbor. My attention was especially called to it in laying out the limits of dredging under a recently completed contract, and while inspecting the work during the progress of dredging I personally noted the great encroachment upon the available harbor area.

When this request for establishment of harbor lines was forwarded me, therefore, I was already convinced of their importance, and at once had a draft of a plan for suitable lines prepared and forwarded. Blue prints of the same were sent to three interested citizens of Greenport, who promised to hold them open for public inspection. On October 16, 1893, a public meeting was held in Greenport, due notice having been given, for the purpose of affording opportunity to interested parties to suggest modifications of the original draft for harbor lines. About twenty-five persons were present at the meeting, and slight changes were suggested, most of which could be accepted without impairing the usefulness of the harbor. A new draft of plan for harbor lines has been made, embodying such of the desired changes as could be made without serious detriment to the harbor as an anchorage ground and as a shipping point for local commerce. This plan harmonizes the several interests as well as possible, and meets with general approval at Greenport.

In planning for an entrance to Sterling Basin, it seemed desirable to widen that entrance by cutting off part of the sand spit on its east side. This sand spit is partly above highwater mark, and is the property of Mrs. S. P. Rackett, of Greenport. Mrs. Rackett has consented to the lines as laid out, and has signed a paper conveying to the United States the right to lay out harbor lines across the sand spit, as shown on the accompanying map, and subsequently to dredge and remove the earth up to such harbor line.

I have, therefore, to report that, in my opinion, harbor lines should be established at Greenport, under section 12 of the river and harbor act of August 11, 1888, as amended and reenacted by the river and harbor act of September 19, 1890, and I submit herewith a map[*] and description showing the location of lines, which I respectfully recommend for approval. I also inclose a copy of the above-mentioned conveyance of right of way signed by Mrs. Rackett.[*]

Very respectfully, your obedient servant,

HENRY M. ROBERT,
Lieut. Col., Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

A. DESCRIPTION OF HARBOR LINES FOR GREENPORT HARBOR, NEW YORK.

Bearings are magnetic, and are referred to the center line of the Joshuas Point Breakwater, which bears north 29° 6′ west, and south 29° 6′ east.

Proposed *pier lines* are as follows: Beginning at a point in the center line of the breakwater 750 feet from high water at its outer end, and running thence (course 1) N. 56° 35′ W., a distance of 1,900 feet; thence (course 2) N. 73° 55′ W., for a distance of 225 feet to the entrance to Sterling Basin; thence (course 3) N. 41° 11′ W., crossing the sand spit on the east side of the entrance to Sterling Basin, a distance of 195 feet; thence (course 4) N. 48° 49′ E., a distance of 400 feet; thence (course 5) N. 41° 11′ W., a distance of 1,200 feet; thence (course 6) S. 48° 49′ W., a distance of 600 feet; thence (course 7) S. 41° 11′ E., passing along the west side of the entrance to Sterling Basin and running a total distance of 1,455 feet; thence (course 8) S. 61° 35′ E., a distance of 260 feet, to a point on the north side of the extension to the north dock at Fordham's shipyard and 65 feet from the outer end; thence (course 9) S. 21° 58′ E., crossing the extensions to the north and south shipyard docks and continuing to and along the easterly face of Fordham's main dock to the southeasterly corner of said dock, a total distance of 432 feet; thence (course 10) S. 27° 18′ W., a distance of 310 feet; thence (course 11) S. 13° 30′ E., on a line straight away from the outer corner of the jog in the southerly side of Fordham's dock, a distance of 815 feet; thence (course 12) S. 65° 55′ W., and in line with the point on the breakwater hereinbefore described as the point of beginning, a distance of 855 feet; thence (course 13) still S. 65° 55′ W., passing the steamboat dock 15 feet away and running to a point near the 12-foot curve and 60 feet out from the easterly face of the railroad dock, a distance of 1,185 feet; thence (course 14) S. 24° 32′ W., passing the railroad dock about parallel to its outer face and following approximately the 12-foot curve for a distance of 1,000 feet.

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[*] Omitted.

Proposed *bulkhead lines* are as follows: Courses 1 and 10, inclusive, coincident with pier lines; thence, in lieu of courses 11 and 12, S. 27° 18′ W., being a continuation of course 10, a distance of 1,290 feet; thence courses 13 and 14, coincident with pier lines.

D 29.

ESTABLISHMENT OF HARBOR LINES IN PATCHOGUE RIVER, NEW YORK.

PATCHOGUE, N. Y., *November 25, 1893.*

DEAR SIR: About June, 1892, under the direction of D. C. Houston, Colonel of Engineers, U. S. Army, survey was made and consent of property owners obtained to establish harbor lines in Patchogue River, which is now being improved by Government appropriation.

This work, we understand, has been interrupted or discontinued by the death of Col. Houston some months since.

It is very desirable that the work be continued and harbor lines defined, to prevent encroachment on the harbor space, which is already limited.

We understand that the work is so far advanced that it can be completed without much additional expense. We consider it very necessary that it should be done in the interest of all using the river as a harbor.

As we are interested in the improvement of the river and own considerable property adjoining it, we respectfully ask that you take such action as you think necessary to continue the work referred to above.

Yours, respectfully,

E. BAILEY & SONS.
By JOSEPH BAILEY.

DANL. S. LAMONT,
Secretary of War.

[Second indorsement.]

OFFICE CHIEF OF ENGINEERS,
U. S. ARMY,
November 28, 1893.

Respectfully referred to Lieut. Col. H. M. Robert, Corps of Engineers, for report.

To be returned.

By command of Brig. Gen. Casey:

H. M. ADAMS,
Major, Corps of Engineers.

REPORT OF LIEUT. COL. HENRY M. ROBERT, CORPS OF ENGINEERS.

ENGINEER OFFICE, U. S. ARMY,
New York, N. Y., January 10, 1894.

GENERAL: I have the honor to submit herewith a plan and description of harbor lines for Patchogue River, New York, in compliance with letter from the office of the Chief of Engineers, dated December 6, 1893.

On December 15, 1893, I went to Patchogue to personally examine the river and the lay-out of the proposed harbor lines, and at the same time to meet any persons interested in the harbor-line matter, due notice of such meeting having been given. The day was stormy, and but seven citizens attended the meeting. They all expressed approval of the plan as shown, and they knew of no one who would object to it. The subject has been thoroughly discussed by all interested parties in Patchogue, and I believe it is generally understood and approved there.

The plan of harbor lines submitted herewith is, in my judgment, suited to the protection of the public interest in the harbor; it also meets the approval of interested individuals without exception, that I could ascertain, and I therefore recommend it for establishment.

Very respectfully, your obedient servant,

HENRY M. ROBERT,
Lieut. Col., Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

[First indorsement.]

OFFICE CHIEF OF ENGINEERS,
U. S. ARMY,
January 13, 1894.

Respectfully submitted to the Secretary of War.

Application having been made to the Secretary of War for establishment of harbor lines for Patchogue River, New York, the subject has been under consideration by Lieut. Col. H. M. Robert, Corps of Engineers, who submits the within report, recommending the establishment of the harbor lines shown in red on the accompanying tracing.*

It is recommended that the harbor lines selected be approved under the provisions of section 12 of the river and harbor act of August 11, 1888, as amended and reenacted by section 12 of the river and harbor act approved September 19, 1890.

THOS. LINCOLN CASEY,
Brig. Gen., Chief of Engineers.

[Second indorsement.]

WAR DEPARTMENT, *January 17, 1894*

The harbor lines selected are approved.

DANIEL S. LAMONT,
Secretary of War.

DESCRIPTION OF HARBOR LINES FOR PATCHOGUE RIVER, NEW YORK.

Bearings are magnetic, and are referred to the meridian observed June, 1892.

The pier lines and bulkhead lines are coincident and described as follows, viz:

East side.—Beginning at a point 10 feet south and 10 feet west from the intersection of E. Bailey & Sons' Lumber Dock with Town Dock, and running thence S. 1° 01′ W. in front of property of E. Bailey & Sons a distance of 620 feet to a point in line with the south side of the slip just north of G. M. Smith's shipyard and 10 feet out; thence S. 15° 20′ E. a distance of 155 feet to a point in line with the north side of the south slip at G. M. Smith's shipyard and 10 feet out; thence S. 33° 14′ E. a distance of 702 feet to a point near shore in front of land of Mrs. K. L. Gilbert; thence S. 1° 42′ W. a distance of 925 feet to a point opposite the bend in the dock owned by Mrs. Gilbert and 20 feet out from the same; thence S. 32° 33′ W. parallel to and 20 feet away from the dock a distance of 100 feet; thence S. 1°

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* Not printed.

27′ E. a distance of 905 feet; thence S. 7° 08′ W., passing along the east bank of the channel dredged in 1893 by the United States in front of land of Gen. Dodge, and continuing a total distance of 550 feet to a point on the east side of the river's mouth; thence S. 55° 49′ E. a distance of 300 feet.

West side.—Starting at the point before described as the point of beginning for the east side and running thence S. 84° 58′ W. parallel with the southerly face of Town Dock and 10 feet therefrom and crossing the harbor to a point 10 feet out from the face of Jones's Dock a distance of 216 feet; thence S. 14° 10′ W. parallel with Jones's Dock and 10 feet away a distance of 145 feet; thence S. 7° 16′ E. a distance of 855 feet; thence S. 33° 14′ E (parallel with the east line at this point) a distance of 420 feet to a point 60 feet out from the face of dock in front of premises of Mrs. C. Murphy; thence S. 1° 42′ W. (parallel to the opposite harbor line) crossing the docks at Martinus Smith's shipyard and running to a point 80 feet beyond the South Dock a distance of 860 feet; thence S. 12° 07′ W. a distance of 540 feet; thence S. 0° 06′ E. passing 5 feet east of the east side of A. W. Lozier's boathouse a distance of 330 feet; thence S. 57° 41′ E. a distance of 280 feet to a point in line with the easterly face of Bailey's New Dock and 30 feet north of said dock; thence S. 2° 43′ W., passing along the face of Bailey's Dock, a distance of 240 feet to the northernmost bend in the face of said dock; thence S. 11° 26′ W. a distance of 345 feet to the east side of the breakwater west of the channel; thence following the east side of said breakwater in a southerly direction to the end of said breakwater, wherever it may be, at present a distance of 1,095 feet, more or less.

APPENDIX E.

IMPROVEMENT OF HUDSON RIVER AND NEW YORK HARBOR AND OF RIVERS AND HARBORS IN THEIR VICINITY, NEW YORK AND NEW JERSEY.

REPORT OF LIEUT. COL. G. L. GILLESPIE, CORPS OF ENGINEERS, OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1894, WITH OTHER DOCUMENTS RELATING TO THE WORKS.

IMPROVEMENTS.

1. Hudson River, New York.
2. Harbor at Saugerties, N. Y.
3. Harbor at Rondout, N. Y.
4. Wappinger Creek, New York.
5. Harlem River, New York.
6. East River and Hell Gate, New York.
7. Newtown Creek, New York.
8. Buttermilk Channel, New York Harbor.
9. Gowanus Bay, New York.
10. New York Harbor, New York.
11. Jamaica Bay, New York.
12. Raritan Bay, New Jersey.
13. Removing sunken vessels or craft obstructing or endangering navigation.

HARBOR LINES.

14. Harlem River, New York.
15. Westchester Creek, New York.

ENGINEER OFFICE, U. S. ARMY,
New York, N. Y., July 2, 1894.

GENERAL: I have the honor to transmit herewith annual reports * * * for the fiscal year ending June 30, 1894, upon the works of river and harbor improvement under my charge.

Very respectfully, your obedient servant,

G. L. GILLESPIE,
Lieut. Col., Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

E 1.

IMPROVEMENT OF HUDSON RIVER, NEW YORK.

The Annual Report of the Chief of Engineers for 1885, Part I, p. 677, contains a history of this improvement, accompanied by original reports and two sketches showing its condition at that time.

The only part of the Hudson River which has been improved by the General Government is a stretch, about 20 miles long, beginning at the head of navigation at Troy, N. Y., about 6 miles above Albany, and extending down the river to New Baltimore, about 14 miles below Albany.

While there has always been enough water below New Baltimore for navigation, this upper section of the river, so far as its history is known to us, has always been obstructed by bars and shoals, due to the existence of numerous islands and sloughs and the consequent diversion of the river's waters through too many channels.

Prior to 1831, when the jurisdiction of the Federal Government over these waters was confirmed by judicial decision, the State of New York had made efforts to improve the navigation of this part of the river.

Since 1831 the improvement of the Hudson River has been conducted both by the State of New York and by the General Government, both building and repairing dikes and doing such dredging as seemed necessary. In the last few years, however, the dike work has been left almost exclusively to the General Government and the dredging to the State of New York.

The general system of improvement has been the same throughout, the contraction of the channels by the construction of jetties and dikes intended to deepen them by means of the scour so produced, and also the lowering of the bed by dredging where such work was indispensable.

But up to 1831 the work, which had consisted almost entirely of the construction of spur dikes and dredging, had produced very little permanent improvement.

After 1831, however, the United States began the present general system of improvement, which consists of contracting the channel by means of longitudinal dikes intended to aid in scouring the bars and shoals, instead of which spur jetties had formerly been used.

Under this system the United States constructed two dikes in 1835, 1836, 1837, and 1838.

Then followed a long interval of time in which nothing was done by the United States except in 1852; but in 1863 the State of New York took up the improvement on the general plan adopted by the United States in 1831, viz, substituting a system of longitudinal dikes instead of the jetty system, and between 1863 and 1867 built six important longitudinal dikes of this kind. (Annual Report of 1885, p. 678.)

The work was again taken up by the United States in 1864, when, out of the general sum appropriated for river and harbor improvements, $33,000 was allotted for the Hudson River improvement, and this was followed by the act of June 13, 1866, which appropriated $50,000 for the same work.

The plan of improvement adopted in 1867 provided for securing a navigable channel 11 feet deep at mean low water from New Baltimore up to Albany and 9 feet deep at mean low water from Albany up to Troy.

The following is a description of the plan:

First. A system of longitudinal dikes, to confine the current sufficiently to allow the ebb and flow of the tidal current to keep the channel clear. These dikes to be gradually brought nearer together from New Baltimore toward Troy, so as to assist the entrance of the flood current and increase its height, their height to be kept approximately at the level of the tidal high water, so as not to confine the freshets, the exact level, however, being left to be determined by experience as the work progresses.

Second. That the dredge be used, so far as necessary, to open the channels above described, which the current should not be allowed to do, except very gradually, lest accumulations dangerous to navigation be formed below.

Third. Keeping, as far as practicable, the side reservoirs open to the passage of tidal currents by gaps at their lower extremities in order to increase the tidal flow.

Fourth. Dumping all dredged material in secure places, where it can not be moved back again into the channel by the current.

Fifth. Constructing the dikes of timber and stone in a manner to secure their permanency at a minimum cost, the details, varying with the locality, to be left to the discretion of the local engineer, to be so designed as to admit of having an increased height given to the dikes if necessary.

Sixth. To protect, when necessary, the banks and islands against the abrading action of the currents by revetments.

Seventh. That limits, beyond which no encroachments upon the channel should be made, be prescribed, and that any such encroachments be reported to the engineer in charge.

The cost of the improvement, according to the estimate of 1867, was $1,000,000, but the amount which had been actually spent upon the project up to June 30, 1892, the date of its practical completion, was $1,247,940.29.

From the nature of the materials which enter into the construction of the dikes and from the limited sums which are applied annually to renew the parts which become unserviceable, whether by natural decay or otherwise, it can be well understood that the estimates prepared from time to time for the completion of the project must be accepted as approximately accurate for only a short period of time. This statement is necessary for a correct understanding of the apparent discrepancy between the estimated and the actual cost of the project.

A new project was adopted in 1891, which provided for maintaining old improvements and constructing new regulating works along 8 additional miles of the river below New Baltimore, and also deepening the entire reach of the river under improvement, so as to afford a channel 400 feet wide and 12 feet deep at mean low water, from Coxsackie to the foot of Broadway, Troy, N. Y., and thence 300 feet wide and 12 feet deep to the State Dam.

The estimated cost of the project is $2,500,000, provided the entire work be completed within five years.

The sanction of Congress to the project was given by the river and harbor act approved July 13, 1892, with the proviso that contracts might be entered into by the Secretary of War for such materials and work as might be necessary to carry out the plan, to be paid for as appropriations may from time to time be made by law, not to exceed in the aggregate the sum of $2,447,906.

The State of New York makes an appropriation at every session of its legislature for the improvement of the Hudson River, and prior to 1867 the money was applied to the construction of dikes on the left bank of the river from Houghtailing Island to Albany, to jetties, dams, and to temporary measures of relief, and also to dredging at the points where shoals were discovered after spring freshets. In the last few years, however, the dike work has been left almost exclusively to the General Government and the dredging to the State.

Sections 6 and 7 of the river and harbor act of September 19, 1890, make it unlawful to dump into the navigable waters of the United States any materials which shall tend to impede or obstruct navigation, or to excavate or fill, or in any manner to alter or modify the course, location, condition, or capacity of the channel of said navigable waters, unless approved and authorized by the Secretary of War. These are wise provisions for the protection of the navigable waters of the United States, and it is hoped that a considerate enforcement of the law will serve hereafter to protect the channel of the river by maintaining its regimen, and at the same time to allow material to be taken freely from the river for private and public uses.

Section 3 of the river and harbor act of July 13, 1892, amendatory of section 7 of the act of 1890, referring to structures which may be authorized in navigable waters, is so important that a copy is here inserted for the information of the public:

> That it shall not be lawful to build any wharf, pier, dolphin, boom, dam, weir, breakwater, bulkhead, jetty, or structure of any kind outside of established harbor lines, or in any navigable waters of the United States where no harbor lines are or may be established, without the permission of the Secretary of War, in any port, roadstead, haven, harbor, navigable river, or other waters of the United States, in such manner as shall obstruct or impair navigation, commerce, or anchorage of said waters; and it shall not be lawful hereafter to commence the construction of any bridge, bridge draw, bridge piers and abutments, causeway, or other works over or in any port, road, roadstead, haven, harbor, navigable river, or navigable waters of the United States, under any act of the legislative assembly of any State, until the location and plans of such bridge or other works have been submitted to and approved by the Secretary of War, or to excavate or fill, or in any manner to alter or modify the course, location, condition, or capacity of any port, roadstead, haven, harbor, harbor of refuge, or inclosure within the limits of any breakwater, or of the channel of any navigable water of the United States unless approved and authorized by the Secretary of War: *Provided*, That this section shall not apply to any bridge, bridge draw, bridge piers and abutments the construction of which has been heretofore duly authorized by law, or be so construed as to authorize the construction of any bridge, drawbridge, bridge piers and abutments, or other works under an act of the the legislature of any State, over or in any stream, port, roadstead, haven, or harbor or other navigable water not wholly within the limits of such State.

The average rainfall covering the past sixty-three years, from observations recorded in the report of the water commissioners of Troy, N. Y., for 1889. is 36.55 inches. The greatest rainfall in any year was recorded in 1878, when 49.23 inches fell; the least rainfall in any year occurred in 1839, when 18.32 inches fell. The greatest known rainfall in any one month occurred in October, 1869, when 13.8 inches fell; the least known rainfall in any one month was in May, 1840, when only 0.2 of an inch fell.

At times during the dry season of most every year, for a month at least, no water flows over the State Dam at Troy, and excepting what comes in through the lockage of the canals there is, during that period, little apparent fresh-water supply to the flow of the river. From this and the fact that the tide rises and falls at the State Dam, it is evident that the navigation of the Hudson River at the low stage is dependent in a large degree upon the tidal prism of the river. The mean rise and fall of tides—

	Feet.
At State Dam, Troy, N. Y., is	.80
At Nail Works, Troy, N. Y., is	1.92
At Albany, N. Y., is	2.32
At Castleton, N. Y., is	2.53
At New Baltimore, N. Y., is	3.42
At New York, Governors Island, from Coast Survey	4.40

The mean duration of rise of tide at Albany is 5 hours 0 minutes, and the mean duration of fall 7 hours 25 minutes.

The plane of mean low water at New York is below that—

	Feet.
At New Baltimore	3.55
At Castleton	4.35
At Albany	4.78
At Troy Nail Works	5.32
At Troy State Dam	6.88

The plane of mean high water at New York is below that—

	Feet.
At New Baltimore	2.57
At Castleton	2.48
At Albany	2.70
At Troy Nail Works	2.84
At State Dam, Troy	3.28

The heights of the greatest known freshets above the plane of mean low water at Albany are as follows:

That of February 9, 1857, due to an ice gorge at Van Wies Point, was 22.19 feet.

That of October, 1869, due to the great rainfall in that month, which reached 13.8 inches, was 19.04 feet.

That of February, 1886, due to an ice gorge, was 17.89 feet.

Generally speaking the effects of rain storms are shown by rise in the river within twenty-four hours. The winds also materially affect the height of water; south and east winds drive the water up the river, causing very high tides, while a north or west wind produces an opposite effect.

WORK DONE DURING THE FISCAL YEAR ENDING JUNE 30, 1894.

At the beginning of the fiscal year the following contracts were in force:

Contract with Edwards, Howlett & Thompson, dated December 23, 1892, which provided for the construction of, and repairs to, 40,000 linear feet of dikes, and the dredging and removing of 4,620,000 cubic yards of material.

Contract with P. Sanford Ross, dated December 19, 1892, which provided for the removal of 190,000 tons of rock and 30,000 tons of sand covering rock in place.

Beside the above the following open market agreements were made during the fiscal year:

Open market agreement with E. M. Payn & Co., dated November 10, 1893, for dredging and removing about 400 feet of the south end of Barren Island Dike.

Open market agreement with William Fuller & Sons, dated March 14, 1894, for driving guide piles to define the dikes submerged during freshet times.

Open market agreement with E. M. Payn & Co., dated April 30, 1894, for removing wreck of canal boat from river near Poplar Island.

The river and harbor act of July 13, 1892, appropriated $187,500 for improving the Hudson River, and the act making appropriations for sundry civil expenses of the Government for the fiscal year ending June 30, 1894, and for other purposes, approved March 3, 1893, appropriated $500,000 for continuing the improvement of the Hudson River, provided that not more than three-fourths of the appropriation should be expended during the fiscal year ending June 30, 1894.

The allotments of the amount appropriated July 13, 1892 (specifications approved by the Secretary of War August 15, 1892), were as follows:

For dredging, and construction and repair of dikes, under contract with Edwards, Howlett & Thompson, $130,000.

For removing rock, under contract with P. Sanford Ross, $25,000.

The work represented by these allotments was required to be completed October 1, 1893.

The allotments of the amount appropriated March 3, 1893, were as follows:

For dredging, and construction and repair of dikes, under contract with Edwards, Howlett & Thompson, $384,000.

For removing rock, under contract with P. Sanford Ross, $90,000.

Three-fourths of the work under each of the latter allotments to be completed July 1, 1894, and the remainder by December 31, 1894.

The work under the contract with Edwards, Howlett & Thompson has progressed very unsatisfactorily, from neglect and bad management on the part of the contractors. The contractors themselves have not given the work much of their immediate attention, but delegated its conduct to a number of inefficient foremen. In consequence but comparatively little efficient progress has been made.

During the season of 1893 the dike work was delayed because the imperfect arrangements which had been made to secure the necessary supply of piles and other material resulted in keeping the five pile-drivers on the work frequently inactive.

The quantity of material removed by dredging was also small by comparison with contract requirements, because of the neglect on the part of the contractors to provide proper plant or adequate places to deposit the dredged material. In the Annual Report for 1893 it was stated that the contractors were preparing dump ground behind New Baltimore Dike, where it was expected to operate a suction dredge that would drive the material back of the dike. With this view the contractors constructed during the year a large machine with two centrifugal pumps capable of handling 4,000 cubic yards of material a day. It was contemplated to have this plant in readiness by June 1, but for various reasons its arrival was delayed until August 7. It was operated only a short time, and, proving a failure, the method was abandoned, and the machine altered and arranged for pumping directly from the channel in connection with the use of scows alongside. It has since been operated in this way, and has taken up a great deal of material, but its results are not altogether satisfactory. A powerful tug is used to tow the machine and the scow into which it pumps, but usually the current is so swift that it is almost impossible to keep proper alignment while at work.

After the abandonment of this method of driving the material behind the dikes, the contractors asked for authority to dump material in the deep indent of the river on the west bank below Catskill. To advance the work, and give them time for securing other sites, authority was granted for the temporary use of this dumping ground. Up to June 15, 1894, 230,000 cubic yards of material had been dumped there, when, the contractors having neglected to provide other dumping grounds, the authority was revoked. Two small dump grounds had previously been made by building a bulkhead from lower end of Shad Island to the Mulls Pile Dike, near the lower beacon, and by building a dam from the lower end of Mulls Stone Dike to the shore, in both of which places 225,000 cubic yards of material have been dumped.

On May 11 these dumps had been filled up, and it was necessary to suspend the dredging at Nine Mile Tree and Mulls until the contractors had made other arrangements for disposing of the dredged material.

In the same month a dumping ground was secured and opened in the old Hellegat Channel, on the east bank near Castleton Light, by building a dam from the lower end of Upper Schodack Creek to Lower Schodack Island, and making an opening to said grounds through the State dike just above Mulls Light. Here it is expected that 300,000 cubic yards of material may be disposed of.

The contractors are again making arrangements to deliver dredged material behind the dikes, using improved modern pumps, and there is the hope that the work of dredging will progress with greater satisfaction in the future than it has done in the past.

The work under the contract with P. Sanford Ross has progressed in a thorough and businesslike manner. The method of using a chisel machine to break up the rock and afterwards employing a dredge to take up the broken material being a somewhat new method, and in consequence experimental, the amount of work done was not equal to expectations. The contractors have, however, constructed an improved machine with four chisels weighing 8 tons each, which has been at work since May 22, and in addition to the ordinary clam-shell dredge used last year they have another with a clam-shell bucket that is closed by steam power, which does excellent work. They are now in position to fully complete the work covered by their allotments by the date specified, December 31, 1894.

The progress made during the fiscal year ending June 30, 1894, under the above contracts and open-market agreements may be summarized as follows:

CONSTRUCTION OF NEW DIKES.

Under contract with Edwards, Howlett & Thompson the following dikes have been constructed during the fiscal year:

Coxsackie Island Dike.—This dike was in course of construction at the beginning of the fiscal year, and was completed October 28, 1893. It is a half dike, designed for a shore protection to prevent erosion, 10 feet wide, 1,523 feet long, and cost $7 per running foot.

Light-House Island Dike.—A similar construction built around the north end of Light-House Island to prevent erosion was completed October 21, 1893; it is 2,134 feet long, and cost $6.18 per running foot.

Schermerhorn Island Dike.—This dike, which extends from the Ridgewood Ice House Dock, on lower end of Schermerhorn Island, to the north end of the present Shad Island Dike, is a double pile dike 10 feet wide and 2,707.5 feet long, and was completed November 30, 1893, at a cost of $6.60 per running foot.

Barren Island Dike.—Four hundred and twenty-five feet of the end of this dike were taken up and removed, and a new dike of similar construction built for a distance of 506.5 feet. It was completed December 2, 1893, at a cost of $7.70 per running foot.

Roah Hook Dike.—To prevent shore erosion a dike was built from the north end of the old Roah Hook Dike 1,021 feet north to the brickyard dock, and completed March 31, 1894, at a cost of $5.71 per running foot.

Campbells Island Dike.—A double pile dike was begun and completed during the fiscal year, extending from the dock at Staats Landing south for a distance of 2,376 feet, at a cost of $7.67 per linear foot.

Base Island Dike.—Work is in progress on the construction of 4,000 feet of this dike, beginning at the mainland of east bank and extending downstream.

Breaker Island Half Dike.—This dike is in course of construction; it extends from south end of the Breaker Island Revetment 1,200 feet southward to the northern end of the Hillhouse Island Revetment.

Breaker Island Revetment.—Preparatory to the construction of this revetment a portion of Breaker Island has to be removed. This work is now in progress, and part of the piles for the footing to the stone revetment have been driven.

REPAIRS TO EXISTING DIKES.

Under contract with Edwards, Howlett & Thompson repairs were made to 1,000 running feet of the Cedar Hill Dike, and repairs are still in progress to 5,000 running feet of the Small Island Dike.

Under open-market agreement with William Fuller & Sons guide piles were driven to mark the following dikes when submerged by freshets: West Dike, Coeymans Middle Dike, Coeymans Dike, Barren Island Dike, Cow Island Dike, and Cedar Hill Dike.

During the fiscal year a total of 10,268 linear feet of new dike were constructed, and repairs made to 1,000 feet of dike. The amount of material furnished and put in place by the contractors were as follows:

260,714 linear feet of pine piling.
4,614 linear feet of round timber.
304,461 feet, B. M., of square timber.
125,841 pounds of tie rods and screw bolts.
63,456 pounds of drift bolts and spikes.
23,284 cubic yards of stone.

DREDGING.

The dredging during the fiscal year has been done principally to relieve navigation and at the same time to conform to the project for a channel 400 feet wide and 12 feet deep.

During the winter of 1892-'93 an ice gorge formed between Cedar Hill and North Coeymans, which occasioned shoals at Cedar Hill, Nine Mile Tree, Mulls Cross-Over, and East Channel, New Baltimore, and during the winter of 1893-'94 the ice gorged in the same location. This gorge created a very serious bar, with a least depth of 5.6 feet, extending across the river just below Castleton Light, and also another shoal near Mulls Lower Beacon. Work has been done at each of these several shoals and navigation relieved.

Work is also in progress deepening channel between Bogart and Stone Lights and removing the New Baltimore Bar. Aside from the above, all the necessary dredging has been done, removing the material covering the Breaker Island and Austins East rocks to facilitate operations by the contractor for rock removal.

The contractors have had from five to seven machines at work most of the time.

The following amounts of material were dredged and removed during the fiscal year:

	Cubic yards.
At Breaker Island	11,583
At Stone Light	29,583
At Winnies Bar	3,061
At Cedar Hill Bar	4,106
At Schermerhorn Island	4,796
At Nine Mile Tree	86,805
At Mulls Cross-Over	178,941
At New Baltimore	225,645
Total	544,520

REMOVAL OF ROCK.

The work of removing Austins Rock to a depth of 12 feet at mean low water, which was in progress at the beginning of the fiscal year, was fully completed July 29, 1893.

Tons of rock removed	332
Tons of sand covering removed	56

The work of removing Austins East Rock was also completed, resulting in the removal of 7,228.8 tons of rock and 983 tons of sand covering.

The east channel line as originally laid out crossed the western half of this reef, but as the bed was chiefly of rock at this locality and the reef lay at the turning point of the channel, it was deemed best to push back the eastern border at Austins East Rock a distance of 25 feet.

The work of removing the rock in front of the Watervliet Arsenal Dock to a depth of 10 feet at mean low water was also completed, after the removal of 1,883 tons of rock and 306 tons of sand covering.

The work of removing the rock at Breaker Island, at Van Wies Landing, and at Mulls Cross-Over is in progress. The quantity removed up to the close of the fiscal year at Van Wies Landing, including an enlarged width of 25 feet on the west bank, aggregates 882.3 tons of rock and 359.5 tons of sand; at Breaker Island, 1,944 tons of rock and 568 tons of sand; and at Mulls Rock, 880 tons of rock.

This makes a total of 13,091.6 tons of rock and 2,259.1 tons of sand covering removed during the fiscal year.

WRECKS.

During the fiscal year 2 wrecks were removed from the river—the wreck of the tugboat *Nettie* from channel near Forbes dock, and a wreck of an old canal boat from river just west of channel near north end of Poplar Island.

HIRED LABOR.

A foreman and 7 men were employed during the months of July, August, September, and October, replacing the stone and repairing the paving in the following dikes: Cedar Hill, Campbell's Island, Bear Island, Overslaugh, Bogart Island, Papscanee, Pleasure Island, and High Dike.

HYDROGRAPHIC AND OFFICE WORK.

The hydrographic party has been occupied, when the weather permitted, in making surveys and examinations, or in staking out work and putting up ranges for the dredges and rock machines. Surveys were made of channel between Cedar Hill, and New Baltimore; also survey of Van Wies Rock, resurvey at Mulls, after dredging, survey of West Channel below Catskill, resurvey of channel between Barren Island and New Baltimore, after dredging, and resurveys at Nine Mile Tree, Mulls, and New Baltimore, to determine condition of channel after the winter, and survey of rock at Mulls Cross-Over, which is still in progress.

During the winter the force was reduced to the assistant engineer and one draftsman. Notes were worked up and platted, and tracings and specifications for the work of the following season were perfected.

GENERAL REMARKS.

When the season of navigation opened in 1893, as stated in last annual report, there were several shoal places in the channel, occasioned by an ice gorge which formed between Cedar Hill and North Coeymans. These shoals were all removed as expeditiously as possible.

During the winter of 1893-'94 an ice gorge formed at the same locality, between Cedar Hill and North Coeymans, and created a very serious shoal at Nine Mile Tree, and a smaller one at Mulls near the Lower Beacon. These shoals have been almost entirely removed, and navigation is quite free, excepting near Stone Light, where there is a shoal which is obstructive at low stages, but which will be removed during the coming summer.

After the removal of the rocky reef now lying in the channel immediately south of the stone dike at Mulls, upon which work is in progress, it is possible that ice jams which have almost annually formed in the vicinity may be of less frequent occurrence.

Dredging has also been in continuous progress, opening up the West Channel at New Baltimore, and while a late survey shows that the channel dredged in 1893 had not filled up, yet it is probable that on account of the width of the river at this point the channel can not maintain itself unless a submerged jetty be built out from the east bank behind Willow Island Light to regulate the flow at the low-water stage.

The amount expended during the fiscal year ending June 30, 1894, inclusive of outstanding liabilities, was $283,992.86.

The amount that can be profitably expended during the fiscal year ending June 30, 1896, is $500,000.

This improvement has been under the local charge of Mr. Charles G. Weir, assistant engineer, who has well and faithfully discharged the duties assigned to him.

This work is in the collection district of New York, Albany being a port of entry

AMOUNTS APPROPRIATED.

Act of—	
June 30, 1834	$70,000.00
July 2, 1836	100,000.00
March 3, 1837	100,000.00
July 7, 1838	100,000.00
August 30, 1852	50,000.00
Total	420,000.00

AMOUNTS APPROPRIATED FOR PRESENT PROJECT AND ITS CONTINUATION.

Act of—	
June 26, 1864, allotment	$33,000.00
June 23, 1866	50,000.00
March 3, 1867	305,188.00
July 25, 1868	85,000.00
April 10, 1869	89,100.00
July 11, 1870	40,000.00
March 3, 1871	40,000.00
June 10, 1872	40,000.00
March 3, 1873	40,000.00
June 23, 1874	40,000.00
March 3, 1875	40,000.00
August 14, 1876	50,000.00
June 18, 1878	70,000.00
March 3, 1879	30,000.00

Act of—Continued.	
June 14, 1880	20,000.00
March 3, 1881	15,000.00
August 2, 1882	10,000.00
July 5, 1884	30,000.00
August 5, 1886	26,250.00
August 11, 1888	75,000.00
September 19, 1890	150,000.00
July 13, 1892	187,500.00
March 3, 1893	500,000.00
Total	1,966,038.00
Received from other sources	792.57
Total	1,966,830.57
Amount expended to June 30, 1894, inclusive of outstanding liabilities	$1,576,620.83

Money statement.

July 1, 1893, balance unexpended		$674,202.60
June 30, 1894, amount expended during fiscal year		210,176.25
July 1, 1894, balance unexpended		464,026.35
July 1, 1894, outstanding liabilities	$73,816.61	
July 1, 1894, amount covered by uncompleted contracts	371,118.05	
		444,934.66
July 1, 1894, balance available		19,091.69
Amount (estimated) required for completion of existing project		1,760,406.00
Amount that can be profitably expended in fiscal year ending June 30, 1896		500,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

COMMERCIAL STATISTICS.

The information contained in the report made in 1890 on the commercial statistics of the Hudson River, by Mr. Charles G. Weir, assistant engineer, was so complete that it is deemed best to repeat it in the report for this year.

The importance of the Hudson as a great waterway of commerce is apparent when it is known that aside from its own local traffic, which in itself is very large, it absorbs all the traffic of the Erie, Champlain, and Delaware and Hudson canals, besides the great coal trade of the Pennsylvania Coal Company at Newburg and the Erie coal trade at Piermont. The average season of navigation of the river is 240 days and that of the canals 220 days.

The Erie Canal, extending from Albany to Buffalo, on Lake Erie, a distance of 352 miles, with a difference of level of 577 feet, and to Oswego, on Lake Ontario, connects the Great Northern Lakes with the Hudson River, and brings in immense commerce from the Northwest and Canada. The principal items of this commerce are lumber and grain.

The Champlain Canal, 60 miles long, connects Lake Champlain with the Hudson River. This lake, which is 93 feet above tide of the Hudson, and whose waters flow into the St. Lawrence, is connected by the Chambly Canal with the St. Lawrence River below Montreal. The principal items of tonnage on this canal are lumber and iron ore. The above canals, with 575 miles of subsidiaries, constitute the New York State canals. The Erie Canal enters the Hudson by three tide-water locks, one at the foot of Twenty-third street, West Troy; one at the foot of Eighth street, West Troy; and a third at the lumber district, Albany.

The Champlain Canal enters the river at Waterford, 3 miles above the State Dam, and boats are locked through the dam to tide water. It is also connected with the Erie Canal, and, through its tide-water locks, with the Hudson River.

The Delaware and Hudson Canal enters the Hudson through Rondout Creek at Rondout, N. Y., and brings the anthracite coal country at Honesdale and the Delaware River into water communication with the Hudson. The principal items of tonnage on this canal are coal, bluestone, and cement. Aside from the above feeders to the commerce of the Hudson, the Pennsylvania Coal Company has a large tide-water coal depot at Newburg, where also the Erie Railroad has a terminal point and transfers large quantities of freight by boat across the river. The Erie Railroad also has a coal depot at Piermont, 20 miles above New York, where preparations are being made to handle a very large supply.

The following statistics include the tonnage received at all points above Spuyten Duyvil Creek, and of the local shipment between points on the river only that shipped is credited to the points from which it was shipped, no entry being made to the total tonnage of the amount received at local points from other local points. The total tonnage also includes all through freight shipped from points up the river that passed the mouth of Spuyten Duyvil Creek going south.

The two principal industries on the river which add materially to the local tonnage are ice and brick. The capacity of the ice houses on and adjacent to the river exceeds 4,000,000 tons, and amount generally harvested 3,500,000. The brick manufactured on the river exceed 850,000,000.

Total tonnage of all shipping points on the Hudson River during 1889, not including the tonnage coming through State canals ....tons..	15,033,309
Value of same	$378,196,094
Total tonnage coming to and leaving tide water through State canals, 1889 ....tons..	3,592,437
Value of same	$108,000,000
Increase of same over tonnage, 1888 ....tons..	326,466
Grand total, tonnage of the Hudson River, including the tonnage through State canals ....tons..	18,582,596
Value of same	$485,733,094

This does not include the value of vessels carrying the above trade, which are equally exposed to the dangers of navigation.

Number of transportation companies for passengers or freight, not including steamboats or pleasure boats	30
Total number of passengers carried, 1889	5,000,000
Total population along the river	450,000

E 2.

IMPROVEMENT OF HARBOR AT SAUGERTIES, NEW YORK.

The harbor of Saugerties is at the mouth of Esopus Creek, which empties into the Hudson River on the west shore, about 100 miles above the city of New York. With the exception of some slight works undertaken by the inhabitants, giving no permanent results, nothing had been done toward the improvement of this harbor until it was undertaken by the U. S. Government in 1887. In 1883 a survey of the harbor was made, under the direction of the engineer officer in charge, which indicated that there was a shoal at the entrance 1,100 feet wide between 6-foot contours, over which the least depth was 3 feet, mean low water. Two plans of improvement were recommended, both providing for the construction of parallel dikes and for dredging the channel between them 7 feet deep, mean low water. (See Annual Report of the Chief of Engineers for 1884, Part I, p. 716.)

The reexamination of the harbor, made in 1887, after the State had done some dredging in the channel, resulted in the submission of a third project, differing from those previously submitted only in the direction to be given to the dikes. The range of tides is 4 feet, approximately.

The project for 1887 was approved, and its execution was begun the same year. (See Annual Report of the Chief of Engineers for 1887, Part I, p. 662.)

The estimated cost of construction of north and south dikes, each 2,300 feet long, and for excavating from the channel between them 30,000 cubic yards of material, was $52,000.

The purpose of the dikes is to contract the channel, to promote the scour of the freshets, and to maintain the improved navigable depths during the low stage of summer, which usually lasts for two months, approximately.

At the close of the fiscal year ending June 30, 1892, both dikes had been completed; the north dike had then a length of 2,058 feet and the south dike a length of 2,363½ feet, and the waterway between them was 260 feet wide.

The inner harbor, west of the shore ends of dikes, was 2,000 feet long, 150 feet wide, and 14½ to 20 feet deep at mean low water. From the steamboat wharf of inner harbor to the Hudson River the navigable channel had been deepened by dredging, giving a width of 150 feet between 9-foot curves.

As the direct result of improvements which have been made by the Government, vessels drawing 12 feet and upward can reach the factories located on the inner harbor at high tide.

WORK DONE DURING THE FISCAL YEAR ENDING JUNE 30, 1894.

The river and harbor act of July 13, 1892, appropriated $5,000 for continuing the improvement.

After the dikes had been put in repair there remained a balance of $2,660 applicable towards the removal of the rocky reef at Barclays Point.

At the opening of the fiscal year no contract was in force, but work by hired labor, using the U. S. drill scow *Hudson*, was in progress removing a portion of the rocky reef at Barclays Point. Operations were continued until August 31, when the funds became exhausted and the drill scow was laid up. At that date the rock for a distance of 68 feet from its northern margin had been cut down to 9 feet at mean low water, affording a much-desired relief to the navigation of the inner harbor.

The improvement should continue and 50 feet more of the rocky point be removed to the same depth. The entrance channel is now in good condition and is 150 feet wide and 8 feet deep at mean low water. The piers also are in fair repair.

The amount expended during the fiscal year ending June 30, 1894, inclusive of outstanding liabilities, was $2,626.47.

The estimate of $5,000 recommended for the fiscal year ending June 30, 1896, will, if appropriated, complete the project of 1887, and if the improvement is to continue thereafter a new project and estimates will be required.

Saugerties is in the collection district of Albany, N. Y., which is the nearest port of entry. The nearest light-house is at the mouth of Esopus Creek.

AMOUNTS APPROPRIATED.

Act of—	
July 5, 1884	$5,000.00
August 5, 1886	15,000.00
August 11, 1888	12,000.00
September 19, 1890	10,000.00
July 13, 1892	5,000.00
Total	47,000.00
Amount expended to June 30, 1894, inclusive of outstanding liabilities	46,809.25

Money statement.

July 1, 1893, balance unexpended	$2,817.22
June 30, 1894, amount expended during fiscal year	2,626.47
July 1, 1894, balance unexpended	190.75
Amount (estimated) required for completion of existing project	5,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	5,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

COMMERCIAL STATISTICS.

The commercial carriers are 5 steamboats for freight and passenger traffic, owned by the Saugerties and New York Steamboat Company, the Saugerties and Albany line, and the Saugerties, Rondout and Hudson line; and 405 sailing and other craft, the former carrying 17,000 passengers annually, and in all aggregating 189,000 tons of freight, valued at $5,484,000, the principal product being general merchandise, bluestone, coal, and lumber.

The population of Saugerties is 5,000.

E 3.

IMPROVEMENT OF HARBOR AT RONDOUT, NEW YORK.

The harbor of Rondout is at the mouth of Rondout Creek, which empties into the Hudson River on its west side, about 90 miles above the city of New York.

From the entrance to the first lock of the Delaware and Hudson Canal, a distance of 3 miles, the creek is a tidal stream, the range of tides being 4 feet, approximately.

Prior to 1871 improvements had been made by private persons and corporations, but no permanent benefit had been derived from them. In 1869 a survey of the harbor was made by the Government with a view to its permanent improvement, and it was then found that the available depth of water in the channel was about 7 feet.

The project of improvement based upon this survey provided for the formation and maintenance of a channel 100 feet wide and 14 feet deep at the mouth of the creek, to be obtained by means of dredging and diking. Two parallel channel dikes were to be built outward, toward and into the Hudson River, their outer ends curving gently downstream, while a branch dike running upstream along the Hudson from the outer end of the north dike was to protect that dike from destruction by running ice. The estimated cost of the work was as follows:

Building the north dike, 748 yards long	$41,600
Building the branch dike, 640 yards long	34,400
Building the south dike, 1,277 yards long	59,600
Dredging channel 3,000 feet long, 100 feet wide, and 14 feet deep at low water, 48,000 cubic yards, at 30 cents	14,400
Contingencies	22,500
Total	172,500

The final length of the north and south dikes was, however, to be determined after observing the effects which they might produce in the removal of the bar as they were gradually extended outward. The work was begun in 1872 and was completed in 1880. It was found by experience that the dikes might be made shorter than originally deemed necessary and the total cost of the work reduced to $90,000, less than two-thirds of the original estimate.

On the completion of the work in 1880 the north dike was 2,200 feet, approximately, with a branch dike running up the Hudson 1,000 feet, approximately, and the south dike was 2,800 feet long, approximately, with a spur to the light-house 330 feet long. The distance between the dikes at the entrance was 350 feet, approximately. As the result of the works of improvement, there was a channel over the bar, from the creek to the Hudson River, 50 feet wide, giving 13½ feet mean low water; 100 feet wide, giving 12 feet mean low water; and 200 feet wide, giving 10 feet mean low water. At the outer end of the dikes the distance between the 12-foot curves was over 300 feet.

The north and branch dikes were originally built to the height of mean high water, while the south dike, for 500 feet west of the light-house, was built only to the level of the half tide. The low part of the south dike was subsequently raised by crib work to mean high water; but even with this increased height the dikes are submerged during storm tides and freshets, and are required to be marked by fender piles to enable vessels to enter the harbor at such times without danger of being wrecked upon the concealed dikes.

The appropriations for this harbor made since the completion of the works in 1880 have been applied exclusively to the repair of the dikes. The improved depths in the channel have been well maintained, but the dikes have greatly deteriorated, partly owing to the ice, partly to the natural decay of the timber, and partly to the undermining of the piles by scour.

The survey of the harbor in September, 1889, indicated a continued improvement of the channel between the dikes, not in the enlargement of the width of the 14-foot channel, but in that of the 9-foot channel, which then had a width of 250 feet.

On the south side of the entrance there has been a slight shoaling, due probably to the removal in 1884 of 150 feet from the outer end of the south pier to meet the wishes of the boatmen, who alleged that their tows required a wider entrance between the piers on that side when coming in with vessels on flood tide. The change in length of the south dike doubtless facilitates entrance at flood tide, but the shoaling of the bar on that side, which is shown by the survey of 1889, makes it probable that the south dike should be increased rather than decreased in length.

The river and harbor act of September 19, 1890, appropriated $5,000 for repairing existing works, which was expended in repairs to north and branch dikes. This work was completed October 28, 1891.

The river and harbor act of July 13, 1892, made an appropriation of $5,000 for repairs to existing works, which was expended in repairs to the north branch dike and the rebuilding of 350 feet of the south dike.

The channel maintains itself in good navigable condition, sufficient for the wants of commerce. While the dikes are in good condition of repair they are much exposed to damage by ice in the river and by boats that frequently run into and break down the timber work at the intersection of the north and branch dikes.

WORK DONE DURING THE FISCAL YEAR ENDING JUNE 30, 1894.

The river and harbor act of July 13, 1892, appropriated $5,000 for repairs to existing works.

At the opening of the fiscal year a contract was in force with William Parrott, dated October 31, 1892, and work was in progress repairing the north and south dikes. The repairs consisted in strengthening and rebuilding 875 linear feet of the south dike, and refilling that dike with stone where settlement had taken place. Also in putting new waling timbers on 105 feet of the north branch dike, and putting new tie-rods and screw bolts in where necessary.

The contract was completed in July. The material furnished and put in place under the contract during the year was—

2,120 linear feet piling.
7,884 feet, B. M., square timber.
6,777 pounds tie-rods.
2,139 pounds screw bolts and spikes
691 cubic yards stone.

Under agreement with the contractor, authorized by the Chief of Engineers July 17, 1893, the wreck of the old canal boat *Estella*, which had been wrecked in midchannel of Rondout Creek, opposite the docks of the Delaware and Hudson Railroad Company, was removed, at a cost of $25.

The lengths of the dikes as now built are—

	Linear feet.
North dike	2,050
North branch dike	1,000
South dike, including spur to the light-house	2,450

These dikes are now all in excellent condition and need no immediate repairs. The channel between them, however, is only in a fair condition.

According to a survey made in 1892, there was at that time a good channel 100 feet wide and 12 feet deep at mean low water, excepting opposite Boyces dock, where a slight shoal had formed, and at the entrance to the harbor on the south side there was then a considerable shoal. This latter has increased very much since then, and has so narrowed up the channel at the entrance as to make it very difficult for vessels to enter the harbor when the tide is running flood. This shoaling is due to the removal in 1884 of 150 feet, and again in 1890 of 50 feet additional, of the outer end of the south dike, to meet the wishes of the boatmen, who alleged that their tows required a wider entrance between the piers on that side when coming in with vessels on the flood tide. When the tide is running flood the water is backed up in the large area south of the south dike, which on the ebb creates an eddy at the eastern end of the south jetty, resulting in the deposit of material at the entrance.

As originally constructed, the south dike was parallel to and 350 feet from the north dike up to a point 350 feet from the extreme eastern end; beyond this point it curved to the southward in such a way that at the extreme end it was 525 feet from the north dike. By the removal of 200 feet of the south dike the north jetty has an overlap of 400 feet, and the tendency for material to be deposited in the eddy has been increased. It is desirable that the south dike should be rebuilt to its original projected length, and if this should not prevent the creation of the eddy at the entrance during the continuance of the ebb, a further extension eastward of the south pier to a point immediately opposite the easterly end of the north jetty may be necessary.

In the Annual Report of the Chief of Engineers for 1889, Part I, p. 765, it was stated that complaint had been made that a narrow shoal existed on the inside 1¾ miles from the light-house, composed chiefly of rock or large bowlders, over which there was a depth of from 5½ to 6 feet, and that it should be removed to a depth of 10 feet. This was again referred to in the Annual Report for 1890, p. 703, and its removal recommended. In the Annual Report for 1891, p. 884, it was stated on the assurance of the State officials that this rock and shoal had been removed by the State of New York during the fall of 1890. Recent investigation and examination by this office show that this rock and shoal have been removed only in part. The rock lies in mid-channel, near South Rondout Ferry, and has a least depth of 7.4 feet over it, and the shoal extends from the ferry 1,500 feet eastward, with an average depth of only 8 feet. As the channel is only about 70 feet wide, both rock and shoal are very serious obstructions, and their removal to a depth of 12 feet at mean low water is recommended.

The amount expended during the fiscal year ending June 30, 1894, inclusive of outstanding liabilities, was $3,256.89.

An appropriation of $15,000 is recommended to maintain the dikes, reconstruct 200 feet of the south dike, remove by dredging the shoals near Boyce's Dock and at entrance to harbor, remove rock from channel near South Rondout Ferry, and deepen the channel to 12 feet at mean low water, for a width of 70 feet, over a distance of 1,500 feet, along the channel from South Rondout Ferry eastward toward the bar at the entrance. This amount will, if appropriated, complete the project of 1872, and if the improvement is to continue thereafter a new project and estimates will be required.

Rondout is in the collection district of New York. The nearest works of defense are those in New York Harbor.

Amounts appropriated.

Act or allotment.	Application.	Amount.
Act June 12, 1872	Diking	$10,000.00
Act March 3, 1873	do	20,000.00
Allotments June 8, 1875:		
From repairs of harbors on Atlantic coast	Repairs	762.18
From contingencies of rivers and harbors, etc	do	237.82
Act August 14, 1876	Diking and repairs	30,000.00
Act June 15, 1878	Diking and dredging	30,000.00
Act August 2, 1882	Repairs and dredging	2,000.00
Act July 5, 1884	do	1,000.00
Act August 5, 1886	Repairs	2,500.00
Act August 11, 1888	do	5,000.00
Act September 19, 1890	do	5,000.00
Act July 13, 1892	do	5,000.00
Total		111,500.00

Amount expended to June 30, 1894, inclusive of outstanding liabilities. $111,500.00

Money statement.

July 1, 1893, balance unexpended	$3,256.89
June 30, 1894, amount expended during fiscal year	3,256.89
Amount (estimated) required for completion of existing project	15,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	15,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

COMMERCIAL STATISTICS.

The commercial statistics of this harbor have not changed materially since report for 1890, at which time there was a total tonnage of 2,467,490 tons, valued at $41,268,850. General merchandise, coal, cement, lime, bluestone, and ice are the principal products handled, and are carried in about 700 vessels, which also carry 75,000 passengers annually.

Of the above tonnage one-half passes through the Delaware and Hudson Canal, which connects the Hudson River at Rondout with the Delaware River at Port Jervis, N. Y., and with Honesdale, Pa., the heart of the Pennsylvania coal region.

The population of Rondout is 25,000.

E 4.

IMPROVEMENT OF WAPPINGER CREEK, NEW YORK.

Wappinger Creek is a small stream which rises in the northern part of Dutchess County, N. Y., near the boundary with Columbia County, and after flowing for about 40 miles through a rich, fertile valley, empties into the Hudson River on the east bank one-half mile below the village of New Hamburg, N. Y.

The appropriation of $13,000 contained in the river and harbor act of September 19, 1890, is the first ever made by the Government for the improvement of the stream, and is based upon the estimate contained in the report, November 11, 1889, upon the survey of Wappinger Creek from Wappinger Falls to its mouth, made to comply with the river and harbor act of August 11, 1888.

At the time of the survey the creek was navigable for vessels and small barges drawing not over 6 feet, in a channel varying in width from 25 feet to 75 feet to Wappinger Falls, 2 miles approximately above its mouth, where a series of falls, with an aggregate height of 86½ feet above mean low water, furnish a valuable water power for three industries, the principal of which is the print works of the Dutchess Company.

The project of improvement contemplated a channel 80 feet wide and 8 feet deep from the mouth to the head of navigation at the falls, and the quantity of material required to be excavated was estimated at 45,000 cubic yards.

At the close of the fiscal year ending June 30, 1892, not only was the project completed, but additional navigable facilities had been given at the head of navigation by opening a channel 40 feet wide and 8 feet deep from deep water of the main branch of the creek to the Wappinger town dock.

The channel in its present condition meets, it is believed, all the wants of commerce.

The balance of $162.85, remaining at the end of last fiscal year, was expended during the fiscal year ending June 30, 1894, for office expenses.

As the approved project has been completed no further appropriation is recommended for this improvement.

Wappinger Creek is in the collection district of New York. The nearest works of defense are situated upon Governors Island, New York Harbor, and the nearest light-house is Danskammer Point Light-House.

Amount appropriated September 19, 1890	$13,000
Amount expended to June 30, 1894	13,000

Money statement.

July 1, 1893, balance unexpended	$162.85
June 30, 1894, amount expended during fiscal year	162.85

COMMERCIAL STATISTICS.

The principal manufactures at the Falls are cotton goods, overalls, clothing, combs, and iron. They are mostly transported by small boats to the mouth of the creek inside of the railroad bridge, where they are transferred to the New York Central and Hudson River Railroad.

The tonnage of the creek during the year 1888 was 70,000 tons. The value of the tonnage was then estimated at $6,500,000. The Dutchess Company shipped 15,500 tons at an estimated valuation of $5,600,000. The traffic is principally carried by sloops, schooners, scows, canal boats, and barges.

E 5.

IMPROVEMENT OF HARLEM RIVER, NEW YORK.

The project for making a navigable water connection between the East River and the Hudson River, by the way of the Harlem River and Spuyten Duyvil Creek, was formulated upon the facts determined by the survey made along this route in 1874, in compliance with the river and harbor act of June 23, 1874, the report upon which may be found on page 224, Annual Report of the Chief of Engineers for 1875, Part II.

This report contains an interesting historical review of the navigation of the Harlem River from the Revolution to the present time.

A full history of this improvement, as now adopted, with the legal proceedings for the acquirement of the land needed for it, and copies of the laws passed by the legislature of the State of New York relative thereto, is given in the annual report of the local engineer in charge to the Chief of Engineers for 1887. (See Annual Report of the Chief of Engineers for 1887, Part I, pp. 665 to 689.)

The streams embraced in the improvement are the Harlem River and Spuyten Duyvil Creek, the former emptying into the East River near Hell Gate and the latter into the Hudson River about 13 miles north of the Battery, and the two together separating Manhattan Island from the mainland.

There has always been an exchange of waters between these two streams at Kingsbridge, though a long ledge of rocks awash at mean low water and an extremely narrow channel at that point have heretofore prevented the exchange being a free one.

High bridge was originally the head of navigation in the Harlem River, but there was a fair channel of about 10 feet depth at mean low water as far as Morris dock, 6 miles from the mouth of the river, and a crooked one of 7 feet depth to Fordham Landing, 1 mile farther; there was no navigation of this latter section, except by rowboats or by small boats used for transporting building material to the "annexed district." Kingsbridge, 1¾ miles from the Hudson River, was the head of navigation in Spuyten Duyvil Creek, but only at high water for vessels drawing 8 feet.

The range of the tides in Harlem River varied from 5.5 feet at Third avenue bridge to 6 feet at the mouth of Dyckman Creek, and in the Spuyten Duyvil Creek was 3.8 feet.

As the difference in the height and times of tides between the East and Hudson rivers, after connection has been made between the Harlem and the Hudson rivers, will produce the currents upon which reliance is placed to keep the channel open, it was desirable that the cross section of the channel be kept as uniform as possible, in order to avoid the unnecessary resistances to the flow of the water which will be caused by any contraction of the waterway.

With this view the contraction of the proposed cut through Dyckman Meadow will be more than counterbalanced by the natural channel through Spuyten Duyvil by the way of Kingsbridge, which is left open, and the contraction caused by the piers and embankments of the High bridge, which carries the Croton Aqueduct across the Harlem River, will be compensated for by deepening the channels between the piers and abutments of that bridge.

Observations of the tides affecting these waters show that there is not a free exchange of tides between Harlem River and Spuyten Duyvil Creek, but that there is practically a divide somewhere near Fordham bridge between the tides flowing from the East River into the Harlem River and from the Hudson River into Spuyten Duyvil Creek. Comparing the tides of the Harlem River at Fordham bridge with those of the Hudson River at the mouth of the Spuyten Duyvil Creek, it is found—

(1) That the level of mean high water in the Hudson is nearly 1 foot (0.961 foot) lower than it is in the Harlem.

(2) That the mean rise and fall of the tide in the Hudson is 2.12 feet less than it is in the Harlem.

(3) That the mean duration of the rise of tides in the Hudson is thirty-six minutes shorter and the mean duration of the fall twenty-six minutes longer than in the Harlem.

(4) The mean level of the Hudson at the mouth of the Spuyten Duyvil Creek is 0.265 of a foot lower than at Fordham bridge.

(5) High water occurs one hour and thirty-four minutes earlier in the Hudson than in the Harlem.

From these facts it follows that while on the opening of the new channel through Dyckman Meadow there will be a free flow east or west, dependent upon the stage of the tides, the preponderance will be westward, and that the mouth of the improved channel will then be at the junction with the Hudson River.

The project for the improvement was adopted in 1879. The proposed lines of improvement, as laid down by the engineer in charge in his annual report for 1882, are as follows:

(1) Below the Harlem or Third avenue bridge the outer pier and bulkhead lines as laid down by the park department are adopted.

(2) Above the Third avenue bridge to the entrance of Dyckman Creek into the Harlem River the exterior pier and bulkhead lines are laid down 400 feet apart.

(3) The line following Dyckman Creek through Dyckman Meadow will pass for a part of the way through solid rock, and it is here that the principal cost of the undertaking must be encountered. This part is to be made 350 feet wide. It would have been preferable to have established it at 400 feet, but the additional amount of rock excavation was the obstacle.

(4) The remainder of the line to the Hudson River will follow, as nearly as possible, the course of the Spuyten Duyvil, and the width will be 400 feet.

(5) The channel depth in the Harlem River and Spuyten Duyvil Creek will be 15 feet at mean low water, and in the channel along Dyckman Creek 18 feet mean low water.

The cost of opening a navigable waterway from the Hudson River through Dyckman Creek to the Harlem River at East Two hundred and eighteenth street, New York City, was estimated in 1875 at $2,100,000, and for dredging the Harlem River thence to Third avenue at $600,000 additional, making the estimated aggregate cost of the improvement $2,700,000.

The project was revised in 1886, by narrowing the channel immediately north of High bridge to 375 feet where it skirts the Ogden estate, on the east bank. This change of width was approved by the Secretary of War October 7, 1886. (See Annual Report of the Chief of Engineers for 1887, Part I, p. 671.)

The legal difficulties for acquiring the right of way along the line of the proposed improvements from the Harlem River to the Hudson River, through Dyckman Meadow, were removed in May, 1887, and immediately thereupon the appropriations of 1878 and 1879, aggregating $400,000, became available, and the project for their expenditure was begun and continued under appropriations of 1888 and 1890.

The work contemplated under the existing appropriations provides for the excavation of all the material contained between the dams; dredging a channel from the east dam through the Harlem River to Fordham dock, and from the west dam to Spuyten Duyvil Creek, and for the removal of the dams. It is expected that when this work is executed there will be a narrow channel between the Hudson and the East rivers navigable at mean low water by vessels drawing 8 feet.

By act of Congress approved March 3, 1881, a survey was made of the Harlem or Bronx Kills, north of Randall Island, and a report was submitted upon the practicability of opening a channel 300 feet wide and 15 feet deep, mean low water, between the East River and the Harlem River by this route, at an estimated cost of $2,000,000. The report will be found in the Annual Report of the Chief of Engineers for 1882, part 1, p. 656. The project was never approved by Congress, and no appropriation has ever been made for its execution.

Harbor lines for the preservation and protection of the navigable waters of the Harlem River and Spuyten Duyvil Creek were established by the Secretary of War October 18, 1890, under authority of the river and harbor act of August 11, 1888.

The department of public parks, New York City, made application to the Secretary of War July 11, 1893, for a modification of the harbor line of the west bank of the Harlem River from near High bridge to and beyond the Washington bridge, to enable an adequate highway to be built along the Harlem River, connecting One hundred and fifty-fifth street with the northern end of Manhattan Island.

The matter was submitted to the Harbor Line Board for New York Harbor and adjacent waters, and on its recommendation the Secretary of War authorized, October 2, 1893, a modification of the habor line as follows:

> Beginning at a point "A" on the harbor line on the west bank of the Harlem River established by the Secretary of War October 18, 1890, 741 feet south of the center line of the western abutment of Washington bridge, the recommended line runs thence northerly in a straight course a distance of 1,630 feet to a point "B" in the said harbor line 889 feet north of the center line of said western abutment. The coordinates of the point "A" are north 6,180.03 and east 741.48, and those of point "B" are north 7,806.61 and east 708.37, the origin of coordinates being the southeast corner of Tenth avenue, at its intersection with One hundred and fifty-fifth street, New York City. The modified line so drawn will pass to the eastward of the eastern face of the western abutment of Washington bridge a distance of 62 feet, approximately, and eastward of the established harbor line at that point a distance of 21 feet.

The modification of the harbor line was accompanied with the permission to the department of public parks to build an iron footway 12 feet in width, carried around the river side of the outer pier of the bridge known as "High bridge" across the Harlem River at New York City, N. Y., said pier being situated upon the western pierhead and bulkhead line along said river.

BRIDGES ACROSS THE HARLEM RIVER.

The following table shows the location and characteristics of the several existing bridges across the Harlem River:

Name and location of bridge.	Width in clear in each draw.	Height of bottom chords above mean high water.	Remarks.
	Feet.	*Feet.*	
Second avenue	103.7	28.5	Double draw, railroad bridge, iron.
Third avenue	82	13.8	Double draw, road bridge, iron.
Third avenue (temporary)	61	4	Double draw, wooden trestle, iron drawspan.
Fourth avenue:			
East span	65	7.2	Double draw, railroad bridge, iron; east span closed by row of piling.
West span	68		
Fourth avenue (temporary)	60	1	Single draw, wooden trestle, iron drawspan.
Madison avenue	132	28	Double draw, road bridge, iron.
Macomb Dam, One hundred and fifty-sixth street (temporary).	76	16.7	Double draw, road bridge, wood; will be removed on completion of new iron bridge at One hundred and fifty-fifth street.
New York and Northern Railroad Bridge at Eighth avenue.	128	28	Double draw, railroad bridge, iron.
High bridge (old aqueduct)	....	....	No draw; stone arch; width between piers, 77.7 feet; clear waterway, 55 feet; crown of arch 100 feet above mean high water.
Washington bridge, at One hundred and eighty-first street.	....	Single span.	No draw; iron arch; span, 500 feet; clear waterway, 420 feet; crown of arch, 136.7 feet above mean high water.
Farmers bridge	....	3.1	No draw; two spans, 22 and 23 feet wide; light timber structure.
Kings bridge	....	4.8	No draw; two spans, 18 and 25 feet wide.
Footbridge at Broadway	....	3	No draw; two spans, 56½ and 58½ feet wide.
Hudson River Railroad bridge, at mouth of Spuyten Duyvil Creek.	50	6.9	Single draw, wooden trestle, iron drawspan.

The following resolution, governing the closing of the bridges across the Harlem River at Madison and Third avenues when the land transportation over the bridges between the two shores is greatest, was adopted by the department of public parks, New York City, November 30, 1892:

Resolved, That from and after the 20th day of December, 1892, the draws of the bridges across the Harlem River at Madison and Third avenues shall not be opened or operated between the hours of 6 and 10 o'clock in the forenoon, and between 4 and 7 o'clock in the afternoon, except when otherwise ordered. This regulation shall not apply to the boats of the fire department, nor to the regular transportation boats of the New York and Northern Railway Company.

BRIDGES AFFECTED BY STATE ACTS, OR BY NOTICES SERVED BY THE SECRETARY OF WAR.

1. *Bridges at Third and Fourth avenues, New York City.*—The city of New York, owning or controlling the bridge at Third avenue, and the New York Central and Hudson River Railroad Company, owning or controlling the bridges at Fourth avenue, were notified by the Secretary of War, July 2, 1890, to modify these bridges in accordance with the recommendations of the Board of Engineers convened May 7, 1890, to consider, as stated in the Annual Report for 1890, the matter of bridges across the Harlem River at Third and Fourth avenues, New York City. These notices required that the modifications called for should be completed by January 1, 1892.

The legislature of the State of New York, by act approved April 5, 1892, authorized and required an increased elevation of the Fourth avenue bridge, and provided for all changes in any avenues, streets, and railroads that may be necessary by reason of such increased elevation. A commission to carry out the provisions of this act was appointed by the mayor of New York City April 25, 1892. This act will enable the railroad company to reconstruct this bridge in conformity with the requirements of the notice of the Secretary of War, which in the absence of the necessary legislative action the company has not heretofore been able to carry out. Plans for the new bridge received the approval of the Secretary of War August 5, 1892.

In order that the traffic across the river may not be suspended while the permanent bridge is in process of construction, the railroad company applied to the Secretary of War for authority to build a temporary bridge, provided with a 60-foot draw and situated 160 feet to the northward of the old bridge. This application was granted May 27, 1892. The railroad company began work of modification in September, 1892, and is pushing it with satisfactory progress.

An act to provide for the reconstruction of the Third avenue bridge was approved by the governor of the State of New York May 2, 1892, and plans for the construction of the new bridge, prepared by the department of public works of New York City, received the approval of the Secretary of War March 24, 1893.

The work of modification was begun in November, 1893.

The temporary bridge which is to carry the traffic across the river during the construction of the permanent bridge is about completed, and the pneumatic caisson for the south rest pier of the permanent bridge is under construction.

2. *Bridge at Broadway crossing.*—An act of the legislature of the State of New York to provide for the construction of a bridge across the Harlem Ship Canal, locally so called, on the line of Kingsbridge road, or Broadway extended, was approved by the governor April 5, 1892. Plans for the construction of this bridge, conforming to the general provisions of the State act of 1879, as to height of lower chord and length of spans, prepared by the department of public works of New York City, received the approval of the Secretary of War February 11, 1893. Work on the construction was begun in June, 1893. Nearly all of the masonry of the piers and abutments of the bridge is now completed, and the erection of the iron work of the superstructure has been begun.

3. *Macomb Dam bridge.*—The State act of April 29, 1890, authorizing the department of public parks of New York City to reconstruct the Macomb Dam bridge at Seventh avenue was amended by a bill which became a law, without the signature of the governor, January 31, 1892. The amendment provides that the awards for property taken shall not be paid out of the $1,250,000 appropriated for the bridge. This bridge is now in process of construction under plans approved by the Secretary of War September 7, 1891.

The masonry of all the piers and abutments is completed, and the iron work of the superstructure is nearly all in place.

Application was made by the city of New York June 14, 1892, for authority to build a temporary bridge 220 feet to the northward of the old bridge, to be used by the public during the construction of the new bridge. This application received the approval of the Secretary of War July 5, 1892, and the bridge was completed August 26, 1892.

4. *Bridge at mouth of Spuyten Duyvil Creek.*—As stated in the last Annual Report, Mr. Alexander J. Howell, on March 4, 1891, made complaint to the Secretary of War that the railroad bridge across the Spuy-

ten Duyvil Creek at its mouth was an obstruction to navigation by reason of "insufficient width of draw," under the river and harbor act of September 19, 1890.

The matter was referred to the local officer, and public hearings were given April 1 and 15, 1891, to the parties in interest.

The complaint was satisfied by the New York Central and Hudson River Railroad Company agreeing, as a temporary measure only, to widen the draw opening to 50 feet, and to erect a steam motor with which to maneuver the drawbridge. This agreement was approved by the Secretary of War June 9, 1891, with the proviso that the modifications agreed upon should be regarded as a temporary measure to meet the necessities of the navigation of the stream as they now exist, and the date fixed for completion of the alterations was December 1, 1891.

Owing to various delays in the preparation of the plans and in letting the work, and further delays on the part of the contractor, the work of erecting the new draw was not begun until April, 1892. The work was completed September 26, 1892.

Plans for the construction of a permanent bridge at this point were submitted to this office by the railroad company on May 31, 1894. As the proposed elevation of the bridge above high water did not conform to the requirements of the river and harbor act of September 19, 1890, nor to those of the State act of May 20, 1879, regulating the height and length of draw span of new bridges across the Harlem River and Spuyten Duyvil Creek, the plans were forwarded to the Secretary of War with the recommendation that they be not approved.

WORK DONE DURING THE FISCAL YEAR ENDING JUNE 30, 1894.

No contracts were in force at the beginning of the year, the last two contracts with John Satterlee having expired June 1, 1893.

Proposals for continuing the work under the changed conditions brought about by the breaking of the dams and flooding of the work during the severe storm of April 21, 1893, were invited July 24, 1893, and with the approval of the Chief of Engineers contract was made with the Morris & Cumings Dredging Company, the lowest responsible bidders, September 8, 1893.

This contract provides for the removal by dredging of 258,000 cubic yards, more or less, of mud, earth, and broken stone from the Harlem River, Spuyten Duyvil Creek, and from the remains of the dams inclosing the rock cut through Dyckman Meadow; for the removal of 5,000 cubic yards of ledge rock under water, in the northeast end of this cut; and for the construction of about 650 linear feet of cribwork and 475 linear feet of pile work revetment for protecting the sides of the section of cut to be excavated.

Operations under this contract were begun September 15, 1893, and at the close of the year the following work had been done:

	Contract quantity.	Removed during fiscal year.	Remaining to be removed.
Dredging:	*Cu. yds.*	*Cu. yds.*	*Cu. yds.*
From Spuyten Duyvil Creek and Meadow west of west dam	40,000	36,413	3,587
From east and west dams, and from canal prism between the two dams	60,000	46,323	13,677
From Meadow east of east dam and in Harlem River	150,000	62,619	87,381
From shoals at Morris Dock and at High Bridge	8,000	10,165	....
Rock excavation:			
Ledge in northeast corner of Dyckman Cut	5,000	4,380	620

Crib-work and pile-work revetment.—Of the 650 linear feet of crib work and 475 linear feet of pile-work revetment called for by the contract, 359 linear feet of crib work and 227 linear feet of pile work were built during the year, all in the west end of the cut through Dyckman Meadow 300 feet of the crib work being located on the south side and 59 feet of the crib work and the 227 feet of pile work on the north side of the cut. These revetments are the westward continuation of the stone retaining walls heretofore built in the west end of the rock cut, and with them form permanent margins to the sides of the cut, as far as it has been excavated, to the full projected width and depth.

Wrecks.—On May 31, 1894, the bid of Mr. John F. Baxter for the removal of an old ice barge lying in the channel off the foot of East One hundred and forty-fifth street was accepted, by authority of the Chief of Engineers. The wreck was successfully removed on June 4, 1894, at a cost of $250.

Removal of rocky obstructions in the lower Harlem River.—Under authority of the Chief of Engineers, granted September 8, 1893, operations for the removal of Candle Factory Reef, off the foot of East One hundred and twenty-second street, were begun on September 11, using the U. S. drill scow *Hudson* and hired labor, and continued to December 27, 1893, when operations ceased on account of cold weather, and the drill scow was laid up for necessary repairs. Work was resumed on April 23, 1894, and is still in progress. During the period covered by the operations 416 holes were drilled, all extending to below the projected depth of 15 feet at mean low water, and 2,250 pounds of forcite were expended. Those portions of the reef having a less depth than 12 feet at mean low water were, however, worked upon chiefly with the view of first obtaining a depth of 12 feet over the entire reef, and, as further funds become available, to extend the improvement to the final depth of 15 feet at low water. The broken rock was dredged up by a grapple dredge, which was employed a total of twenty-six and one-half working days, removing 1,300 cubic yards of ledge rock and bowlders that overlay the ledge in parts. The least depth on the reef when operations were begun was 1.7 feet at low water, and at the close of the year a depth of 10 feet had been obtained. The southerly end of the ledge is covered by a deposit of mud, sand, and embedded bowlders, which extends into the channel from the west shore, and it will be necessary to remove this material by dredging before the increased channel width which the removal of the reef proper will afford can be fully utilized by vessels navigating the stream.

As the result of the year's work, all the ledge rock remaining in the northeast end of the cut through Dyckman Meadow was removed, excepting about 600 cubic yards, covering an area of 50 by 60 feet, with a least depth of 12.7 feet over it at mean low water, and most of which rock is broken up but has not yet been excavated to the full projected depth. The remains of the dams at the west end of the cut were removed to a depth of 18 feet at mean low water, and the section of meadow lying directly west of the west dam was excavated to a depth of from 12 to 15 feet below low water, to a connection with the channel dredged under former contracts through the bed of Spuyten Duyvil Creek and intervening meadows to the Hudson River, thus establishing a continuous waterway from the Hudson River to the new drawbridge now under construction across the canal at Broadway, Kingsbridge. From the rock cut westward the improved channel is from 140 to 150 feet wide and 9 feet deep at mean low water, while the rock cut itself has a depth of 18 feet at low water and a width of about 350 feet.

In the Harlem River the dredged channel, which at the beginning of the year had been excavated from a point about 600 yards north of Morris Dock to within 200 feet of the east dam, with a depth of 9 feet at mean low water and width of about 160 feet, was advanced northward to within 120 feet of the temporary bridge located directly east of the east dam, and built by the city of New York for use during the construction of the above-mentioned permanent bridge at this point. There is an opening about 120 feet wide in the east dam through which a free exchange of tides takes place, but navigable communication between the Hudson and Harlem rivers is shut off by the temporary bridge, which is not provided with a draw span. The channel at the crossover directly south of Morris Dock was deepened from a depth of 8 feet to a depth of 10 feet at mean low water, for a width of 150 feet, by the removal of bowlders and other hard material, and the waterway through the east and west bays of High bridge was cleared of bowlders and other obstructions to a depth of 10 feet at low water, so that vessels drawing 10 feet can now safely ascend the river at low water as far as Morris Dock, from which point, as already stated, 9 feet can be carried in a channel 140 to 160 feet wide to within 120 feet of the temporary bridge at Broadway, which structure is now the only barrier to a navigable communication between the Hudson and East rivers.

It is expected that the new bridge will be completed by October, 1894, after which time the removal of the remains of the old east dam and the construction of the timber revetments in the east end of the Dyckman cut, as far as provided for by the existing contract, will at once be proceeded with.

The amount expended during the fiscal year ending June 30, 1894, inclusive of outstanding liabilities, was $108,539.39.

This improvement can not be well or economically conducted except under large appropriations. The amount that can be profitably expended during the fiscal year ending June 30, 1895, is $500,000.

A full statement of the commerce likely to be benefited by the improvement is subjoined.

Mr. A. Doerflinger, assistant engineer, has been in local charge of this improvement during the year. He has remained constantly upon the work and has discharged his duties with his accustomed fidelity and efficiency.

Harlem River is in the collection district of New York. The nearest light-house is on Blackwells Island.

AMOUNTS APPROPRIATED.

Allotment June 23, 1874, from appropriations for East and Harlem rivers.	$11,000.00
Act of—	
March 13, 1875	10,000.00
June 18, 1878	300,000.00
March 3, 1879	100,000.00
August 11, 1888	70,000.00
September 19, 1890	250,000.00
July 13, 1892	175,000.00
Total	916,000.00
Amount expended to June 30, 1894, inclusive of outstanding liabilities..	845,715.31

Money statement.

July 1, 1893, balance unexpended		$178, 824. 08
June 30, 1894, amount expended during fiscal year		89, 581. 44
July 1, 1894, balance unexpended		89, 242. 64
July 1, 1894, outstanding liabilities	$18, 957. 95	
July 1, 1894, amount covered by uncompleted contracts	49, 035. 92	
		67, 993. 87
July 1, 1894, balance available		21, 248. 77
Amount (estimated) required for completion of existing project		1, 805, 000. 00
Amount that can be profitably expended in fiscal year ending June 30, 1896		500, 000. 00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

Abstract of proposals for improving Harlem River, New York, received in response to advertisement dated July 24, 1893, and opened August 24, 1893, by Lieut. Col. G. L. Gillespie, Corps of Engineers.

Material, etc.	(1) Atlantic Dredging Co.		(2) Morris & Cumings Dredging Co.		(3) Thomas Potter.	
	Per unit.	Amount.	Per unit.	Amount.	Per unit.	Amount.
Dredging 40,000 cubic yards of material from Spuyten Duyvil Creek and meadow west of West Dam ..... cubic yard..	$0. 16	$6, 400	$0. 19	$7, 600. 00	$0. 21	$8, 400
Dredging 60,000 cubic yards of material from East and West dams, and from canal prism between the two dams ..... cubic yard..	. 30	18, 000	. 28	16, 800. 00	. 30	18, 000
Dredging 150,000 cubic yards of material from meadow east of East Dam and from the Harlem River ..... cubic yard..	. 18	27, 000	. 22½	33, 750. 00	. 20	30, 000
Dredging 8,000 cubic yards of material from shoals at Morris Dock and High Bridge, cubic yard	. 80	6, 400	. 30	2, 400. 00	. 45	3, 600
Removing 5,000 cubic yards ledge rock from the cut through Dyckman Meadow, cubic yard	......	......	4. 98	24, 900. 00	7. 20	36, 000
Crib work for revetment, workmanship exclusive of material (540,000 cubic feet), cubic foot	......	......	. 02⅛	11, 475. 00	. 02	10, 800
Pile-driving for revetment (27,000 linear feet), linear foot	......	......	. 14	3, 780. 00	. 09	2, 430
Round timber for crib and pile revetment (172,000 linear feet) ..... linear foot..	......	......	. 05$\frac{9}{10}$	10, 148. 00	. 06	10, 320
Square timber for crib and pile revetment (110,000 feet, B. M.) ..... M. ft., B. M..	......	......	34. 90	3, 839. 00	30. 00	3, 300
Iron tie-rods, screw bolts, driftbolts, spikes, and washers (54,000 pounds) ..... pound..	......	......	. 03⅞	2, 092. 50	. 03½	1, 890
Stone filling for crib work and pile revetment, stone furnished by contractor (18,000 cubic yards) ..... cubic yard..	......	......	. 47½	8, 550. 00	. 70	12, 600
Stone filling for crib work and pile revetment, using Government stone (18,000 cubic yards). cubic yard	......	......	. 49½	8, 910. 00	. 70	12, 600
Total	......	* 57, 800	......	†125, 694. 50 ‡125, 334. 50	......	137, 340

Abstract of proposals for improving Harlem River, New York, etc.—Continued.

Material, etc.	(4) Anthony M. Clegg.		(5) P. Sanford Ross.		(6) Lee McCallum.	
	Per unit.	Amount.	Per unit.	Amount.	Per unit.	Amount.
Dredging 40,000 cubic yards of material from Spuyten Duyvil Creek and meadow west of West Dam ....cubic yard..	$0.24½	$9,800	$0.20	$8,000	$0.29	$11,600
Dredging 60,000 cubic yards of material from East and West dams, and from canal prism between the two dams............cubic yard..	.38	22,800	.33	19,800	.36	22,800
Dredging 150,000 cubic yards of material from meadow east of East Dam and from the Harlem River..........................cubic yard..	.24½	36,750	.20	30,000	.29	43,500
Dredging 8,000 cubic yards of material from shoals at Morris Dock and High Bridge, cubic yard....................................	.95	7,600	.35	2,800	.50	4,000
Removing 5,000 cubic yards ledge rock from the cut through Dyckman Meadow, cubic yard..	4.00	20,000	7.00	35,000	6.75	33,750
Crib work for revetment, workmanship exclusive of material (540,000 cubic feet), cubic foot..	.02	10,800	.01½	8,100	.04	21,600
Pile-driving for revetment (27,000 linear feet), linear foot..	.16	4,320	.11	2,970	.18	4,860
Round timber for crib and pile revetment (172,000 linear feet) ....linear foot..	.07	12,040	.04¾	8,170	.07½	12,900
Square timber for crib and pile revetment (110,000 feet, B. M.) ....M. ft., B. M..	45.00	4,950	35.00	3,850	40.00	4,400
Iron tie-rods, screw bolts, driftbolts, spikes, and washers (54,000 pounds)...........pound..	.03	1,620	.03½	1,890	.05	2,700
Stone filling for crib work and pile revetment, stone furnished by contractor (18,000 cubic yards).............................cubic yard..	.40	7,200	.50	9,000	.80	14,400
Stone filling for crib work and pile revetment, using Government stone (18,000 cubic yards), cubic yard..	.40	7,200	.50	9,000	.80	14,400
Total	....	137,880	....	129,580	....	176,510

* Bid informal. † Using Government stone. ‡ Lowest bid.

COMMERCIAL STATISTICS.

The commercial statistics for the fiscal year ending June 30, 1893, have remained practically unchanged, and are therefore herein repeated.

As there is no navigable communication between the Harlem River and Spuyten Duyvil Creek, the present navigation of the Harlem River is practically confined to that part of the stream between its junction with the East River and Satterlee's Dock, at foot of Two hundred and twentieth street, a distance of about 8 miles.

Spuyten Duyvil Creek is navigable from its junction with the Hudson River to Kings Bridge, a distance of 1¾ miles.

The actual commerce of the Harlem River and Spuyten Duyvil Creek for the fiscal years ending June 30, 1890, and June 30, 1893, was as follows:

Items.	1890.	1893.	
	Tons.	*Tons.*	
General merchandise	1,379,334	3,232,052	$159,635,435
Grain, flour, feed, etc	400,987	596,306	15,147,478
Lumber and timber	346,858	451,702	7,462,463
Building material..	642,922	602,217	2,791,100
Fuel	508,365	878,234	4,573,836
Ice	112,000	149,865	539,460
Total..	3,390,466	5,910,876	190,149,712

The total tonnage for the year 1893 shows an increase over that of 1890 of 2,519,910 tons, or about 75 per cent, during the three years. This increase is largely due to the increase in the amount of freight handled at the docks of the New York, New Haven and Hartford Railroad Company, directly below Second avenue bridge, where alone

3,243,850 tons were received and shipped, as compared to 1,407,882 tons received and shipped in 1890. At the docks of the New York and Northern Railway Company, near High Bridge, 166,066 tons were received and shipped. Of the balance of the tonnage, 2,475,275 tons were distributed among the various docks on the Harlem River between its junction with the East River and Satterlee's Dock at Two hundred and twentieth street, and 25,185 tons at various points on Spuyten Duyvil Creek.

As near as can be determined the traffic on the river was carried by the following vessels:

Canal boats, barges, and railroad car floats	20, 361
Sailing vessels, schooners, lighters, etc	4, 476
Steamers and tugs, exclusive of naphtha launches	15, 241
Total	40, 078

A large proportion of the freight handled at the railroad docks is carried in and out of the Harlem on railroad car floats and transfer boats connecting the railroads of New Jersey and Pennsylvania, terminating at Weehawken, Hoboken, and Jersey City, with those of New England, while the general commerce of the river is carried on mainly in barges and canal boats in tow of steam tugs, and in schooners and the smaller class of sailing vessels.

E 6.

IMPROVEMENT OF EAST RIVER AND HELL GATE, NEW YORK.

The East River is the name given to the narrow tidal strait which connects New York Harbor with Long Island Sound. It forms an entrance to the harbor of New York secondary in importance only to the main entrance by way of Sandy Hook and the Narrows, since the heavy coasting trade carried on by New York and the New England States and the British American Provinces passes almost exclusively through it.

The population now gathered around the waters of New York Harbor numbers nearly 3,000,000, and should the present rate of increase, as shown by the census returns, be maintained for half a century longer, the population would then be about 8,000,000.

New York City can grow only in one direction, and that is into Westchester County, on the north, since on all other sides it is surrounded by water; and the development of the water fronts along the Hudson and East Rivers must, therefore, be certain and rapid. With the development the importance of the East River entrance to New York Harbor will increase enormously; and it seems not unreasonable to predict that within the next fifty years every foot of shore line on both sides of the East River within 15 miles of Harlem River and Hell Gate will be occupied with wharves filled with shipping, engaged not only in the coasting and transatlantic trade, but in the commerce of the world.

The East River is crooked and narrow in places and much obstructed by rocks and affected by violent currents.

The worst of these obstructions was originally that known as Hell Gate, lying at the mouth of the Harlem River, between Blackwells and Ward islands, about opposite Ninety-sixth street, New York. Here the river turns at right angles around Hallets Point, divides into several channels, and runs with a velocity, varying at different stages of the tide from 3 to 10 miles an hour, over or around Hallets Point, Negro Point, Ways Reef, Shell Drake, Pot Rock, Frying Pan, Heel Tap, Holmes Rock, Hog Back, Flood Rock, Hen and Chickens, Gridiron, the Negro Heads, Mill Rocks, Rhinelander Reef, and Bread and Cheese.

On account of the violence and irregularities of the currents and the crowded condition of this passage, wrecks at Hell Gate were numerous prior to 1867. At that time some of these rocks projected above the water level, while the least depth over others at mean low water varied from nothing to 20 feet. In obedience to the provisions of the act approved June 23, 1866, an examination was made of Hell Gate by the local engineer, with the view of its improvement for purposes of navigation, and three separate projects were submitted January 21, 1867, for the improvement, affording channels of 26 and 24 feet in depth at mean low water. The project which was adopted in 1867 (see Annual Report of the Chief of Engineers for 1868, p. 741) provided for the removal of the rocks and reefs that lie directly in the channel to a depth of 26 feet at mean low water, and for the building of sea walls and dikes upon others that lie near the edge of the channel, in order to guide the currents in such a way that vessels might pass the reefs in safety. The cost of the project was estimated at $8,692,645.15. The removal of Hallets Point was begun in 1869 and the final blast occurred September 24, 1876. A new estimate was made January 3, 1870, "based upon the process of tunneling the larger reefs, as Hallets Point and the Middle Reef, and removing the smaller reefs by drilling from the surface of the water," and the cost was placed at $4,689,820.

The estimate was again revised in 1874 to include the removal of Diamond and Coenties reefs (see Annual Report of the Chief of Engineers for 1874, part 2, p. 164), and the total cost fixed at $5,139,120. It provides for the removal at Hell Gate to a depth of 26 feet, mean low water, of the reefs at Hallets Point, Ways Reef, Shell Drake, Pot Rock, Frying Pan, Heel Tap, Negro Point, and Flood Rock, including the Gridiron, Hen and Chickens, and Negro Heads, and the construction of a dike to connect the Mill Rocks and sea walls upon Hog Back and Holmes Rock; and, in other parts of the East River, for the removal of Diamond Reef and North Brothers Island Reef to a depth of 26 feet, Coenties Reef to a depth of 25½ feet, and the small rocks known as Scaly Rock, Blackwells Rock, and the rock off Woolsey's bath house.

The work of mining Flood Rock began in June, 1875.

In 1880 the débris arising from the excavation of the galleries in Flood Rock was deposited partly in a dike to connect Great and Little Mill Rocks, and in 1882 a protection wall was built by the city authorities upon the reef at the head of Blackwells Island known as "Bread and Cheese."

The great blast was fired October 10, 1885.

The project was enlarged in 1884 to include the removal of Pilgrim Rock, off Nineteenth street, to 24 feet, mean low water; and again in 1889 to include removal of the reef off Diamond Reef, Ferry Reef, off Thirty-fourth street, and Charlotte Rock, northwest of entrance to Newtown Creek, to 26 feet, mean low water; work to be done by hired labor with drill scow.

A steam-drill scow fitted with a movable iron dome working within a central well was put in operation in the winter of 1870–'71 for the removal of subaqueous reefs. Its results have been most satisfactory, as by its use rock swept by the swift currents of the East River are easily drilled and blasted.

The stone broken by the blasts are sometimes removed by appliances attached to the scow, but usually by use of the Government dredges employed at Hell Gate.

At the close of the fiscal year ending June 30, 1893, the following parts of this project had been executed: Hallets Point, covering 3 acres; Ways Reef, Shell Drake, Diamond Reef, North Brothers Island Reef, Coenties Reef, reef off Diamond Reef, Baretto Reef, and Scaly Rock, had been removed to the depth contemplated in the project; Pilgrim Rock and Ferry Reef had been reduced to a least depth of 24 feet; Heel Tap had been broken to 26 feet and dredged to 20.5 feet; and the least depths on Frying Pan and Pot Rock were 18 feet and 22.8 feet at mean low water, respectively; Flood Rock and connecting reefs, covering 9 acres, had been broken to 30 feet and 198,502 tons of débris had been removed; the Negro Heads and Hen and Chickens had been reduced to 18 feet, mean low water, and a new 18-foot channel, 500 feet wide, opened across the reef.

Shell Reef off Ninth street has been reduced to 18 feet, mean low water, except at a few points.

Hell Gate, as has been said, is the worst obstruction found in the East River; but there are rocks and reefs in other parts of this crowded waterway which are constant sources of danger to passing vessels which have often been complained of and which ought to be removed.

The first to be mentioned is the long line of reefs and isolated rocks in mid stream, extending 1½ miles downward from the foot of Blackwells Island, which have always been troublesome to vessels beating up against the wind or crossing from one channel to the other, as the winds and tides often compel them to do, and which, with the continually increasing size of vessels and the increasing commerce of the river, are becoming still more dangerous. The Man-of-War Rock, marked by a spindle, opposite Thirty-eighth street, and the Thirty-fourth street rock (now removed) are prominent parts of this reef.

A second and still more serious obstruction to the navigation of the East River that is constantly complained of by mariners is Middle Ground, which is situated in mid-channel 1½ miles to the eastward of Hell Gate, near the southern entrance to Little Hell Gate, between Sunken Meadows and Lawrence Point, with a channel on either side of barely 350 feet width. A project for lowering this reef to the plane of 18 feet, mean low water, has been approved.

The suit begun by private parties to dispossess the United States of its occupancy of the dike built by it between Great and Little Mill rocks, Hell Gate, was decided by the courts in May, 1889, in favor of the United States, but appeal has been taken by the complainant to a higher court. It is highly important that the United States retain possession of the dike, as the ground is very much needed for wharfage and for repair shops for the steam-drill scow and the dredges. The old machinery and worn-out plant and material stored for many years at Hallets Point have been sold at public auction, and the office for the local conduct of this improvement has been transferred to the dike.

The plant in active use on the improvement has been put in good repair during the year.

The Secretary of War established, March 9, 1892, harbor lines around Great and Little Mill rocks, Hell Gate, restricting the construction of piers and bulkheads to high-water line.

WORK DONE DURING THE FISCAL YEAR ENDING JUNE 30, 1894.

At the opening of the fiscal year no contract was in force, but operations were in progress by hired labor, using Government dredges.

1. *Hell Gate.*—The U. S. engineer dredge *Flood Rock* continued work at Flood Rock until December 20, 1893, at which time it was

transferred to Reef off Sunken Meadow for the purpose of relieving a private dredge then under charter.

The following table shows in detail the work done during the year:

Days worked		121
Hours worked		972
Surface blasts fired		32
Dynamite fired	pounds..	2,250
Rock removed	tons..	5,513
Raised per day	do..	45.6

Total quantity of broken stone removed since explosion October 10, 1885:

	Tons.
By contract	83,097
By hired labor, using Government plant	120,918
Total	204,015
The total estimated quantity of rock remaining to be removed is	95,707

The dredged rock has been dumped, as heretofore, in the deep hole off Eighty-ninth street, East River. This has not caused any perceptible decrease in depth, the soundings there still ranging from 80 to 120 feet, mean low water.

The result of all the work to the close of the fiscal year has been to increase navigable depths over Flood Rock Reef practically to 26 feet, mean low water, over an area equivalent to one-half that of the original reef.

Flood Rock proper has been lowered to 20 feet, mean low water, and the channel between this reef and the Government dike connecting Great and Little Mill Rocks, 18 feet deep, mean low water, over the part involved in the explosion; elsewhere the least depth is 20 feet, approximately.

On September 20, 1890, a special report on this improvement was submitted, in which the statement is made that for the year ending June 30, 1890, the cost of removing the broken stone by the Government plant was \$1.08$\frac{3}{10}$ per ton, as contrasted with the lowest bid for doing the work by contract in that year of \$2.19 per ton. For the year ending June 30, 1891, the cost was \$1.35; for the year ending June 30, 1892, \$1.46; for the year ending June 30, 1893, \$1.48, and for the past year \$1.44, including the cost of repairs to plant. The cost of removing the stone increases proportionately with the increase in the depth of water at the site of removal.

2. *Reef off Sunken Meadow.*—U. S. engineer drill scow *Gen. John Newton* continued operations on this reef until December 28, 1893. Dredge *Hell Gate* was employed in raising the rock broken by the operations of the drill scow until September 13, on which date it caught fire during the night and its upper works were destroyed. The hull was taken to the engineer depot at Mill Rock and will be repaired as soon as funds become available.

Morris & Cumings's dredge No. 6 was employed from November 20 to December 20 and on the latter date was replaced for reasons of economy by U. S. engineer dredge *Flood Rock*. On December 23 dredge *Flood Rock* was run into and sunk during a heavy fog by the ferryboat *Wiehawken*. A contract for raising the sunken dredge was made with John Austin, of Philadelphia, Pa., March 8, 1894, and is still in force. When raised the dredge will be repaired, if, on examination, it is considered advantageous to do so.

On May 4 Morris & Cumings's dredge No. 6 was again employed to remove the loose masses of broken rock, and continued until June 6, 1894.

On November 22, 1893, the barge *Milton*, with a cargo of coal, was wrecked on the north side of Reef off Sunken Meadow. The cargo was at once removed by the owners and several unsuccessful attempts were made to raise the vessel. On January 20, 1894, the barge slipped off into deep water adjacent to the reef. Two of her masts had been removed before she disappeared, and the remaining mast was broken off immediately above the deck by a charge of dynamite. The wreck lies in 85 feet of water, with 50 feet of water over her deck.

The following table shows the work done during the fiscal year and the total to date on this reef:

	During fiscal year.	Total to date.
Number of times dome was lowered	57	70
Number of holes drilled	333	432
Total depth of holes drilled ... feet	2,454	3,151
Actual time running drills ... hours	284	353
Average depth of holes ... feet	7.4	7.3
Number of drill-hole blasts fired	56	69
Pounds of explosive used (forcite No. 2)	17,664	22,823
Tons of broken stone raised by divers	183	239
Tons of broken stone raised by pump	90	131
Tons of broken stone raised by dredge	6,560	7,227
Total tons raised and dumped	6,833	7,597
Total cost of work	$28,610.62	$34,894.57
Cost per ton	$4.19	$4.60

As stated in the Annual Report of 1893 the amount appropriated by river and harbor act of July 13, 1892, was sufficient to provide for eighteen months' work, and in the absence of an appropriation for the fiscal year ending June 30, 1894, operations had to be suspended December 28, 1893, and the plant laid up.

The plant belonging to this work, consisting of U. S. steam drill scow *Gen. John Newton*, U. S. steam drill scow *Hudson*, U. S. tugs *Ant* and *Gen. A. A. Humphreys*, U. S. dredge *Hell Gate*, U. S. schooner *Brenda*, 4 dump scows, 1 tender scow, and 1 water boat have been laid up at the engineer wharf at Mill Rock since January 1, 1894, and have been cared for and maintained.

The amount that can be profitably expended in the removal of obstructions in East River and Hell Gate during the fiscal year ending June 30, 1896, is $250,000, to be applied to the removal of Flood Rock and of Reef off Sunken Meadow, and the removal of rocky obstructions at such other points in the East River as the necessities of navigation demand, notably Charlotte Rock and unnamed rock off Twenty-sixth street, discovered in 1893.

This work is in the collection district of New York. The nearest port of entry is New York City. The nearest light is Blackwells Island Light. The nearest fort is Fort Columbus, Governors Island, New York Harbor.

AMOUNTS APPROPRIATED.

Act of—

July 25, 1868	$85,000.00
April 10, 1869	178,300.00
July 11, 1870	250,000.00
March 3, 1871	250,000.00
June 10, 1872	225,000.00
March 3, 1873	225,000.00
June 23, 1874	225,000.00
March 3, 1875	250,000.00

Act of—		
August 14, 1876		$250,000.00
June 18, 1878		550,000.00
March 3, 1879		250,000.00
June 14, 1880		200,000.00
March 3, 1881		200,000.00
May 4, 1882		50,000.00
August 2, 1882		200,000.00
July 5, 1884		360,000.00
August 5, 1886		112,500.00
August 11, 1888		250,000.00
September 19, 1890		200,000.00
July 13, 1892		150,000.00
Received from other sources		3,719.62
		4,264,519.62
Deduct amount reverted to U. S. Treasury	$3,158.55	
Deduct amount allotted to Harlem River	11,000.00	
		14,158.55
		4,250,361.07
Amount expended to June 30, 1894, inclusive of outstanding liabilities.		4,238,953.49

Money statement.

July 1, 1893, balance unexpended	$64,555.48
June 30, 1894, amount expended during fiscal year	53,147.90
July 1, 1894, balance unexpended	11,407.58
Amount (estimated) required for completion of existing project	888,840.67
Amount that can be profitably expended in fiscal year ending June 30, 1896	200,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

COMMERCIAL STATISTICS.

The commercial statistics for the fiscal year ending June 30, 1890, have remained practically unchanged, and are therefore herein repeated.

The registered tonnage, exclusive of coastwise vessels and local steamers, so far as it can be ascertained, is 10,165,325 tons.

The commerce of the East River is so intimately connected with that belonging to New York Harbor proper that it is impossible to make a separate statement for it.

The following list of vessels, not inclusive of daily passenger and freight steamers, passing through Hell Gate for the fiscal year ending June 30, 1890, has been compiled from the maritime records at Whitestone, Long Island, kept by the New York Herald:

	Bound east.	Bound south.
Steamers	642	1,048
Ships	23	13
Barks	115	56
Brigs	80	61
Schooners	5,493	10,528
Tugs	680	682
Barges	2,612	2,862

E 7.

IMPROVEMENT OF NEWTOWN CREEK, NEW YORK.

Newtown Creek is a tidal stream about 4 miles long, running through the eastern part of Brooklyn and emptying into the East River opposite Thirty-fourth street, New York. The range of tides is 4½ feet, approximately, but the bed of the creek has no natural slope.

In 1857 it had a depth of about 17 feet, which had decreased in 1880 to about 12½ feet at low water from its mouth up to the Vernon avenue bridge, a distance of 1,100 feet, its width for this distance being about 240 feet. Thence it gradually decreased in width and depth until at the head of navigation, where the Metropolitan avenue crosses it, there was a low-water depth of about 4 feet and a width of about 100 feet.

A survey of this creek with a view of its improvement was made in 1879 by the engineer officer then in charge, to comply with the act of March 3, 1879, and a report submitted January 31, 1880. The project provided for dredging a channel from the mouth of the creek to Vernon avenue bridge 200 feet wide and from 21 to 22 feet deep at low water, requiring the removal of 145,000 cubic yards of material, chiefly mud, the cost of which was estimated at $36,250.

Work under this project was begun in 1880, but by reason of increased cost of dredging the estimated cost was increased to $44,050.

Under the act of Congress passed August 2, 1882, another survey was made, and a report submitted December 26, 1883. (Annual Report Chief of Engineers, 1884, p. 765.)

The new project provided for carrying the improvement from the Vernon avenue bridge up to the head of navigation in both branches of the creek. The estimated cost of executing this project was as follows:

To excavate a channel 18 feet deep and 175 feet wide from Vernon avenue bridge to the Central Oil Works, 145,500 cubic yards excavation, at 30 cents per cubic yard	$43,050
Thence 15 feet deep and from 125 to 150 feet wide to Queens County Oil Works, 101,600 cubic yards of excavation, at 35 cents per cubic yard	35,560
Thence 12 feet deep and 125 to 150 feet wide to Nichols's Chemical Works, 52,600 cubic yards excavation, at 40 cents per cubic yard	21,040
Thence 10 feet deep and 100 to 125 feet wide to the head of navigation on both branches, 231,600 cubic yards excavation, at 40 cents per cubic yard	92,640
Contingencies	19,229
To which must be added the revised estimate for work below Vernon avenue bridge, before given	44,050
Total estimated cost of improving Newtown Creek	255,569

The appropriations of 1884 and 1886 were applied in deepening the channel from the entrance to Vernon avenue bridge to 18 feet mean low water, and from Maspeth avenue eastward to the head of navigation 10 feet, mean low water. The amount appropriated up to and inclusive of act August 5, 1886, was $82,500, of which amount the sum of $50,750 has been applied from Vernon avenue bridge to the East River, and $31,750 from Covert Dock upstream to the head of navigation on both branches. These appropriations were made in small amounts and at wide intervals, and the work done by them gave only temporary relief. According to these methods the amounts applicable for improvement at the entrance were about sufficient to remove deposits which had been made during the interval, leaving no balance for increasing the depth beyond 20 feet. The improvement could not, for want of funds, be extended to benefit the central reach of the river above

Vernon avenue bridge, and in the absence of secure bulkheads dredging in the upper branches was of little avail. It would have been better had appropriations been made in such a way that the improvement above Vernon avenue bridge could have been executed as an extension of the improvement below it. Then, as the improvement advanced upstream, the wharves along the banks would have been benefited progressively and in proportion to their importance.

A revised estimate for the improvement was made in 1889 (Annual Report Chief of Engineers, 1889, Part I, p. 778), after the results obtained by the survey of January, 1889, had been studied, and the cost was fixed at $170,586.

In preparing the new project for the improvement it was kept in mind that the draft of vessels going above Vernon avenue bridge, where the most important wharves are located, was limited by the then available depth of water, and that many vessels had to be lightered at the bar to facilitate entrance at high tide, while those going out had to complete their cargoes after they reached the East River. It was therefore thought best to provide for 21 feet from the entrance to Vernon avenue bridge, 18 feet to Central Oil Works, 15 feet to Queens County Oil Works, 12 feet to Nichols's Chemical Works, and 10 feet to Metropolitan avenue bridge, on both branches.

The bed of the creek below Vernon avenue bridge is variable in character below the plane of 18 feet mean low water. Near the bar it is composed of sand or sand and clay mixed; but as the bridge is approached it grows harder, like hardpan, and has large bowlders embedded in it. The creek has a very sluggish current, and where there are no bulkheads the deposits arising from the sewers and from the degradation of the soft and unstable banks cause obstructions to navigation, for which annual dredging is the only possible relief.

The river and harbor act of September 19, 1890, appropriated $35,000 for continuing the improvement, which was applied throughout the main river, giving 21 feet at the entrance and 10 feet at the head of navigation. In the "English Kills," a northern branch of the river skirting Laurel Hill, a channel was made 700 feet long, 100 feet wide, and 10 feet deep, mean low water. The contract was closed August 24, 1891.

The river and harbor act of July 13, 1892, appropriated $35,000 for continuing the improvement. The work provided for by this appropriation was let to contract, as stated in last annual report, and the project under it was completed and work suspended March 27, 1893.

At the close of the fiscal year the channel from the entrance to Vernon avenue bridge was 175 feet wide at the entrance and 150 feet wide near the bridge, and was 18 feet deep, mean low water. The channel from Vernon avenue bridge to Central Oil Works was 80 feet wide and 16 feet deep, mean low water; from Central Oil Works to Queens County Oil Works, 100 feet wide and 14 feet deep; from Queens County Oil Works to Nichols's Chemical Works, 75 feet wide and 10 feet deep; from Nichols's Chemical Works to Maspeth avenue, 50 feet wide and 10 feet deep; from Maspeth avenue to Metropolitan avenue, on the east branch, 100 feet wide and 10 feet deep; and on the west branch, 50 feet wide and 10 feet deep. In the English Kills branch the channel was 100 feet wide and 8 feet deep from Nichols's Chemical Works to a point 700 feet to the eastward.

The following table shows the location and characteristics of the several bridges crossing Newtown Creek:

Name and location of bridge.	Width of draw.	Height of bottom chord above mean high water.	Remarks.
	Feet.	*Feet.*	
Vernon avenue	63	7.3	Road bridge; double draw; iron on wooden pier; opens by hand power.
Blissville bridge (Greenpoint avenue).	58	8.9	Road bridge; double draw; wood on wooden pier; opens by hand power.
Penny bridge (Meeker avenue).	65	9.7	Road bridge; double draw; iron on stone pier; opens by hand power.
Grand street bridge	57	5.8	Iron on stone pier; single draw road bridge; opens by hand power.
Metropolitan avenue bridge (Metropolitan avenue and Grand street junction).	62	8.7	Road bridge; double draw; iron on stone pier; opens by hand power.

WORK DONE DURING THE FISCAL YEAR ENDING JUNE 30, 1894.

At the opening of the fiscal year no contract was in force.

Nothing was expended during the fiscal year ending June 30, 1894.

The estimate of $78,000 recommended for the fiscal year ending June 30, 1896, will, if appropriated, complete the project of 1883, and if the improvement is to be continued thereafter a new project and estimates will be required.

The Secretary of War caused a notice, dated April 11, 1892, to be served upon the supervisors for Kings and Queens counties, New York, requiring the bridge across Newtown Creek at Meeker avenue to be altered in such a manner as to place the outer faces of the abutments on the bulkhead line established by the Secretary of War December 29, 1890, and to provide a draw opening on either side of the pivot pier 65 feet wide in the clear. The date of completion first fixed at October 1, 1892, was afterwards extended to January 1, 1893. Owing to unavoidable delays, the alterations were not completed till February 26, 1894, at which time the bridge was again thrown open to travel.

The first public hearing in the matter of the complaint against the Vernon avenue bridge was held July 13, 1893. After many postponements, granted at the request of the supervisors, who expressed themselves anxious to replace the bridge by a tunnel, the last hearing was held November 20, and the final report to the Chief of Engineers was submitted December 14, 1893. In the report it was recommended that the supervisors of Kings and Queens counties, owning or controlling the bridges, be required to place and maintain the existing bridge in good repair, and to apply and maintain a modern motor attachment to the draws, pending action, not later than May 1, 1894, by the State legislature, expected to provide for the construction of either a tunnel or a high bridge under or over the site of the existing bridge. These recommendations were approved, and an appropriate notice conforming thereto was served upon the supervisors, by direction of the Secretary of War, December 22, 1893.

An enabling act for the construction of a tunnel at Vernon avenue crossing was passed by the State legislature in May, 1894, but was vetoed by the governor.

In view of the veto, the Secretary of War, before giving final judgment upon the matter of the bridge, directed that the parties in interest should have another and final hearing. The hearing was held Wednesday, June 20, after which final report was submitted recommending that the requirements contained in the original notice of the Secretary of War served upon the supervisors December 22, 1893, be carried out.

This work is in the collection district of New York; nearest port of entry, New York City; nearest light-house, Blackwells Island Light; nearest fort, Fort Columbus.

Amounts appropriated.

Application.	Date.	Amount.
Dredging below Vernon avenue bridge	June 14, 1880	$10,000
Do	Aug. 2, 1882	15,000
Part applied above Vernon avenue bridge	July 5, 1884	20,000
Below and above Vernon avenue bridge	Aug. 5, 1886	37,500
Newtown Creek and Bay	Aug. 11, 1888	25,000
Do	Sept. 19, 1890	35,000
Do	July 13, 1892	35,000
Total		177,500

Amount expended to June 30, 1894, inclusive of outstanding liabilities, $177,500.

Money statement.

Amount (estimated) required for completion of existing project	$78,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	78,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

COMMERCIAL STATISTICS.

The commercial statistics for the fiscal year ending June 30, 1890, have remained practically unchanged, and are therefore herein repeated.

Imports and exports.

Articles.	Amount.		Value.
	Imported.	Exported.	
Lumber ... feet, B. M.	263,040,852	21,000,000	$5,930,994
Coal ... tons	440,410		1,652,794
Oil ... cases		2,937,272	2,900,000
gallons	19,949,255	29,252,557	3,026,509
Residuum ... do	20,093,200	1,378,148	623,438
Grain ... bushels	140,000		140,000
Brick	125,000,000		650,000
Lime and cement ... barrels	260,000		260,000
Stone and sand ... tons	105,000		107,000
Chalk ... do	20,000		70,000
Tin, lead, iron, and steel ... do	9,776	500	905,791
Oil of vitriol ... pounds	20,457,437		135,840
Jute, hemp, manila, etc ... tons	200,000		2,000,000
Empty barrels and cases	577,058	1,036	460,033
Naphtha ... gallons		6,464,226	381,983
Candles and wax ... pounds		11,765,064	
Separated acid ... gallons		1,035,695	19,366
Miscellaneous ... tons		24,075	2,236,521
Total			22,045,745

Vessels arriving and departing.

Class.	Number.	Tonnage.
Steamers	12	15, 240
Ships	26	31, 200
Barks	125	87, 500
Brigs	13	10, 400
Schooners	2, 226	1, 113, 000
Lighters	1, 022	204, 400
Barges	2, 782	556, 400
Canal boats	3, 068	306, 800
	9, 274	2, 324, 940

There were built on Newtown Creek 23 new vessels, 7,200 tons capacity, and valued at $265,000.

E 8.

IMPROVEMENT OF BUTTERMILK CHANNEL, NEW YORK HARBOR.

Buttermilk Channel is the name given to the channel which separates Governors Island, at the mouth of the East River, New York Harbor, from the city of Brooklyn, which lies east of it.

The channel on the northwest side of Governors Island, which separates it from the lower end of the city of New York, is the wider and deeper of the two, and is the channel most used by vessels passing between the East River and other parts of New York Harbor.

Buttermilk Channel was formerly obstructed by three shoals:

(1) A shoal lying above and northeast of Governors Island, projecting into Buttermilk Channel and extending over to the main channel on the other side, which originally had a least depth over it of 9½ feet at mean low water.

(2) A shoal putting out from Red Hook Point on the Brooklyn side, and extending up the eastern side of the channel to the entrance to the Atlantic Basin, with a least depth on it of about 6 feet at mean low water and an average depth of from 10 feet to 12 feet mean low water.

(3) A shoal putting out from the southern side of Governors Island and extending toward the Red Hook Point Shoal, which is partly dry at mean low water.

A narrow and crooked channel about 30 feet deep lies between the two latter shoals.

Between the first-mentioned shoal and Governors Island there was formerly a narrow channel with 30 feet of water in it, and between this shoal and the Brooklyn shore a channel of the same depth, also originally narrow.

The line of docks and wharves from the Brooklyn bridge down to the mouth of the Atlantic Basin on the Brooklyn side is one of the most important in the New York Harbor and this part of the river, extending from the Brooklyn bridge to Governors Island, was formerly regarded by pilots and masters of vessels as one of the most difficult places in New York waters to carry a vessel through safely on account of this shoal, the rapid current, and the enormous traffic passing not only up and down, but across the stream.

Tows, tugs, small steamers, and small craft generally, in passing up and down this part of the East River, keep to the New York side, forcing the larger class of sound steamers, ocean steamers, and seagoing ships in tow of tugs to keep over toward the shoal at the upper point of Governors Island, and if, as was often the case, these vessels were obliged to stop in order to avoid collision with ferryboats, sloops, and canal-boat tows, they were liable to drift upon this shoal.

Upon a statement of these difficulties, made by shipping merchants and others whose business lay along the Brooklyn wharves between Wall Street Ferry and the Atlantic Basin, a survey of this shoal was ordered in 1872, and a project for its improvement was adopted in 1880.

The appropriations made by the several river and harbor acts from June 4, 1880, to August 11, 1888, both inclusive, have been so applied as to complete the removal of this shoal to a depth of 26 feet, mean low water, at an estimated cost of $346,000.

The contract for final work was closed July 3, 1891.

The river and harbor act of September 19, 1890, made provision for the survey of Red Hook Shoal, lying at the southern entrance to the Buttermilk Channel, "opposite the southeast side of Governors Island," and the report thereon, dated October 17, 1890, states that the shoal contains 1,484,048 cubic yards of material, scow measurement. The estimated cost of removal was $529,000.

WORK DONE DURING THE FISCAL YEAR ENDING JUNE 30, 1894.

At the opening of the fiscal year a contract was in force with the International Contracting Company of New York City, dated September 26, 1892, under the river and harbor act of July 13, 1892, appropriating $100,000 for continuing the improvement.

This contract called for the removal of 340,000 cubic yards, more or less, at 32$\frac{1}{10}$ cents per cubic yard; work to begin December 15, 1892, and to be completed June 1, 1894.

As the northern part of this shoal was composed of heavy sand mixed with bowlders, the contractors deemed it advisable to have plant specially built for its removal.

Immediately after the contract was signed, the construction of the plant was let to contract, but it was not till early in the following spring that it was delivered for trial. When tried the plant proved inadequate, and needed many changes before it became satisfactory in its operations.

In consequence of these delays, the amount which had been removed at the close of the fiscal year, June 30, 1893, was only 32,308 cubic yards.

During the year which has just closed, the results have been more satisfactory.

Starting at red buoy No. 2, which marks the northwestern edge of the shoal, the channel has been widened toward the Brooklyn shore by successive cuts carried east and west across the entire shoal.

At the close of the year 11 such cuts have been made, with an aggregate width of 440 feet, and the amount of material removed has been 345,090 cubic yards.

When the shoal is entirely removed Buttermilk Channel, south and west of the entrance to Atlantic Basin, will be 1,000 feet wide, and the set of the currents will be so direct along the southern margin of Governors Island that the improved depth of 26 feet will be maintained in the channel with reasonable certainty without requiring the construction of an artificial bank upon that island or upon the shoal extending from it to the southwestward.

The amount expended during the fiscal year ending June 30, 1894, inclusive of outstanding liabilities, was $117,416.88.

An appropriation of $200,000 is recommended for the completion of this improvement, which is required to facilitate navigation through Buttermilk Channel, now obstructed by the Red Hook Shoal.

This work is in the collection district of New York. The nearest port of entry is New York City, and the nearest work of defense, Fort Columbus, New York Harbor. The nearest light-house is Robbins Reef.

Amounts appropriated.

Application.	Date.	Amount.
Dredging	June 4, 1880	$60,000
Do	Mar. 4, 1881	60,000
Do	Aug. 2, 1882	60,000
Do	July 5, 1884	10,000
Do	Aug. 5, 1886	56,250
Do	Aug. 11, 1888	100,000
Do	July 13, 1892	100,000
Total		446,250
Received from other sources		100
Total		446,350

Amount expended to June 30, 1894, inclusive of outstanding liabilities, $445,413.07.

Money statement.

July 1, 1893, balance unexpended	$118,353.81
June 30, 1894, amount expended during fiscal year	117,416.88
July 1, 1894, balance unexpended	936.93
Amount (estimated) required for completion of existing project	404,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	200,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

COMMERCIAL STATISTICS.

The commercial statistics for the fiscal year ending June 30, 1890, have remained practically unchanged, and are therefore herein repeated.

The commerce of Buttermilk Channel is so intimately connected with that of New York Harbor that it is impracticable to determine the amount and value.

The number and tonnage of vessels loading and unloading at the Brooklyn wharves immediately fronting on Buttermilk Channel during the fiscal year ending June 30, 1890, as shown by the Maritime Register, is as follows:

Vessels arriving and departing.

Class.	Number.	Tonnage.
Steamers	1,047	1,430,192
Ships	253	389,996
Barks	1,632	783,360
Brigs	312	99,600
Schooners	714	214,200
Total	3,958	2,917,348

This does not include the numerous lighters and canal boats, of which no record is kept.

E 9.

IMPROVEMENT OF GOWANUS BAY, RED HOOK, GOWANUS CREEK, AND BAY RIDGE CHANNELS, NEW YORK HARBOR.

Gowanus Bay is a part of New York Harbor, lying at the mouth of Gowanus Creek, in the southwestern part of the city of Brooklyn. The depth of water in the channel was formerly 7 to 12 feet at mean low water, which was wholly insufficient for the passage of the vessels employed in the commerce of the district. A survey of Gowanus Bay and Creek was made in 1880, and a project for their improvement was submitted in January, 1881.

This project provided for dredging a channel on the north side between the pier lines established by the commissioners appointed by the State of New York in 1875, beginning at the bay and extending up the creek to Hamilton avenue bridge, 18 feet at mean low water, and 200 feet wide, except for the upper few hundred feet near the bridge, where the width was to be gradually reduced from 200 feet to 100 feet.

The total length of the proposed channel was about 9,000 feet, and the total estimated cost of improvement was $182,500.

The proposed channel, however, did not follow the old channel at the mouth of the creek, since the pier line established by the State commission of 1875 crossed the old channel at that point and encroached upon the water grant of the riparian owners.

The owners of this property, Messrs. Beard & Robinson, were anxious, nevertheless, to have the old channel improved instead of having the new one formed, as proposed, outside of the established pier line, but as this could not be done they surrendered their right to build out to the pier line. They signed a paper relinquishing their right to build piers which should obstruct the old channel so long as that channel should be permitted to exist; and the Maritime Association of New York at the same time petitioned that the old channel should be kept open. As the improvement of this channel would, however, help only the land near it on the north side, and not at all that which lay on the opposite or southerly side of the creek, the local officer recommended that the conflict of interests should be settled by dredging the natural channel from the Hamilton avenue bridge down to the southwest corner of the Erie Basin; and that from that point two channels be dredged, one running northerly along the west side of the Erie Basin to deep water, near Red Hook, and the other running across the bay at the entrance and thence southerly along the wharves on the south side of the bay, toward Bay Ridge.

Both of these channels were to be 200 feet wide and 18 feet deep at mean low water.

This project required for its execution a larger amount of work than the original scheme called for, namely:

The excavation of 583,530 cubic yards of material, which, at 30 cents per cubic yard, would cost	$175,059.00
Contingencies, 10 per cent	17,505.90
Total	192,564.90

In the absence of any special governmental legislation legal measures conforming to State requirements and necessary for securing the right of way across Beard & Robinson's property, at the mouth of the creek, were completed satisfactorily, after some delay, in May, 1883, and under appropriations of 1881, 1882, and 1883 the proposed Red Hook branch of the channel was dredged 100 feet wide for a length of 2,000 feet, measured from Red Hook; and the southern channel, running toward Bay Ridge, was begun at the southern end and carried northward for a distance of 1,900 feet, to near Forty-third street, with depths varying from 21 to 17 feet, except for a few hundred feet at the upper end on the eastern side, where the last cut was left unfinished.

The sum of $7,500 was appropriated by the act of August 5, 1886, and was applied toward the improvement of the Red Hook and Gowanus Creek Channel, which at the close of the contract for dredging, March 12, 1887, was 200 feet wide and 18 feet deep from the entrance to the foot of Court street, Brooklyn, and thence 40 feeet wide and 15 feet deep to Sigourney street.

A sketch of the work, June 30, 1885, may be found in the Annual Report Chief of Engineers for that year, Part I, p. 672.

Under the estimates of $192,564.90, only $72,500 had been appropriated to June 30, 1887.

In the Annual Report for 1888, p. 615, the local officer stated that the dimensions previously adopted for the two channels were too small in view of the great increase in length and draft which had taken place lately in the construction of sea-going vessels, especially steamers, and recommended that the depth of these channels be increased to 21 feet mean low water, and their width to 400 feet, while to facilitate the handling of vessels in the contracted space near the mouth of Gowanus Creek, and to enable those drawing 21 feet of water to pass directly from the Bay Ridge Channel at Fortieth street to the Red Hook Channel at the southwestern entrance to Erie Basin, without requiring them to go to the junction of the channels at Twenty-eighth street, it was farther recommended that the triangular shoal area separating the two channels at the entrance be deepened to 21 feet mean low water.

It was estimated that these changes would involve the removal of 1,345,000 cubic yards of material, measured in place, as follows:

Red Hook Channel (from entrance to Henry street):		
To deepen it to 21 feet	cubic yards	70,000
To widen it to 400 feet	do	100,000
Total		170,000
Gowanus Creek Channel (from Henry street to Hamilton avenue bridge):		
To deepen it to 21 feet	cubic yards	350,000
To cut away at the angle	do	300,000
Total		650,000
Bay Ridge Channel (from Twenty-eighth street to Sixteenth street, South Brooklyn):		
To deepen it to 21 feet	cubic yards	250,000
To widen it to 400 feet	do	275,000
Total		525,000
Total, in place	cubic yards	1,345,000
Which, at 40 cents per cubic yard, would cost		$538,000
Contingencies		62,000
Total		600,000

The river and harbor act of August 11, 1888, making appropriations for continuing the improvement, reads as follows:

> Continuing the improvement by dredging to 21 feet mean low water, and widening the channel to 400 feet on the northerly side from the foot of Percival street along the wharves to the 23-foot curve opposite the entrance to Erie Basin, $60,000.

This provided for the commencement of the first and second parts of the project recommended in 1888. The required width of 400 feet at the entrance could not be obtained without dredging inside the pierhead and bulkhead line established by the State in 1875, and the upper 3,000 feet of the creek could not be made 400 feet wide without interfering with the vested rights of property on the west side to such a degree as to practically prohibit the execution of the project. The project which was accordingly adopted for the application of the appropriation provided that the channel to be ultimately dredged should be 400 feet wide from the entrance to the eastern end of the Erie Basin, and carried thence 250 feet wide to the foot of Percival street, where provision would be made again for widening the channel by dredging out the three triangular spaces or slips on the north side immediately below that street.

Operations under the contract of February 27, 1889, for the removal of 300,000 cubic yards of material from Red Hook and Gowanus Creek channels, extending from the entrance near the western entrance to Erie Basin to Percival street, were completed February 26, 1891, and the channel was then throughout 100 feet wide and 21 feet deep, mean low water.

The river and harbor act of September 19, 1890, appropriated $60,000 for improving the channel at Gowanus Bay, New York, to be applied on the northerly side (Red Hook and Gowanus Creek channels), from the foot of Percival street along the wharves to the 23-foot curve opposite the entrance to the Erie basin.

The contract for this work, which was dated January 8, 1891, was completed April 30, 1892. The channel was then 230 feet wide from entrance to Twenty-eighth street and 150 feet wide thence to Percival street.

The same act appropriated $100,000 for a channel 400 feet wide and 21 feet deep on the south shore (Bay Ridge Channel), from Twenty-eighth street south along that shore to the 21-foot curve near Bay Ridge.

The contract for this work, dated January 8, 1891, was completed June 18, 1892. The channel was then 120 feet wide from Twenty-eighth street to Thirty-ninth street and 90 feet wide thence to Sixtieth street.

The adopted project for the improvement of Gowanus Bay, therefore, contemplates a channel on the north and south sides of the bay each 400 feet wide and 21 feet deep at mean low water, and the removal also to the depth of 21 feet of the triangular shoal at the entrance to the bay embraced between the two channels.

The river and harbor act dated July 13, 1892, made an appropriation for continuing the improvement of Gowanus Bay channels of $100,000, "for distribution by allotment between the Red Hook and Gowanus Creek channels, at the discretion of the Secretary of War." The allotment, as made by the Secretary of War, was $58,000 for the former and $42,000 for the latter.

The same act appropriated $98,600 for completing the improvement of Bay Ridge Channel.

Harbor lines were established by the Secretary of War March 4, 1890, on both shores of Gowanus Bay.

To remove any misapprehension as to their exact location on the *north shore*, it seems best to repeat that the pierhead and bulkhead lines so established are coincident throughout from the foot of Ferris street to Hamilton avenue, South Brooklyn. They lie ***exterior to the***

Erie Basin and follow to the foot of Court street the exterior sea-wall line established by chapter 298, Laws of the State of New York, 1875; and thence to Hamilton avenue follow the bulkhead line established by chapter 763, Laws of New York, 1857.

In regard to the harbor lines for the *south shore* of Gowanus Bay (along the Bay Ridge Channel), adopted by the Secretary of War March 4, 1890, attention is invited to the fact that "the piers between the adopted pier and bulkhead lines may be filled with solid material when an equal tidal prism is provided in compensation therefor behind the authorized bulkhead lines and adjacent to said piers." (Annual Report Chief of Engineers, 1890, p. 815.)

WORK DONE DURING THE FISCAL YEAR ENDING JUNE 30, 1894.

General improvement, Red Hook and Gowanus Creek channels.—At the opening of the fiscal year a contract was in force with The International Contracting Company, dated January 6, 1893, for the improvement of the three channels under appropriation of river and harbor act of July 13, 1892. The quantity of material to be removed was 1,285,000 cubic yards, at the price of 13.7 cents per cubic yard, distributed as follows:

	Cubic yards.
Red Hook Channel	370,000
Gowanus Creek Channel	275,000
Bay Ridge Channel	640,000

As work did not begin under this contract until May 22, 1893, the quantity removed from Red Hook and Gowanus Creek channels prior to July 1, 1893, was only 13,331 cubic yards. During the year the contractor has generally had two machines constantly at work, and the quantity of material removed was 342,270 cubic yards.

The project for the improvement of Red Hook Channel, affording a waterway 400 feet wide and 21 feet deep, mean low water, will probably be completed in October, 1894.

The project for Gowanus Creek Channel will not be completed till sometime in the autumn. At the close of the fiscal year it is 215 feet wide at Henry street and 185 feet wide at Percival street, and 21 feet deep.

The amount expended on these two channels during the fiscal year ending June 30, 1894, inclusive of outstanding liabilities, was $56,298.01.

Bay Ridge Channel.—At the opening of the fiscal year a contract was in force with The International Contracting Company, dated January 6, 1893, for the removal of 640,000 cubic yards of material. Operations under the contract began June 17, 1893, and the quantity removed prior to July 1, 1893, was 6,996 cubic yards.

The contractor's plant, as it came from the manufacturers, was defective in many respects, and the results of the spring work proving less satisfactory than the requirements demanded of so large a contract, an effort was made by this office in June, with the approval of the contractor, to supplement the plant by an open-market agreement with other contractors, at a price not exceeding the contract price of 13.7 cents per cubic yard.

After inviting proposals from the largest contractors in the city, the local officer was authorized by the Secretary of War June 29, 1893, to make an open-market agreement with Mr. James D. Leary, in accordance with his proposal dated June 6, 1893, for the removal of 640,000 cubic yards at 13⅝ cents per cubic yard.

The proposal of Mr. Leary was accepted July 5, and this contractor immediately thereafter began work with a plant consisting of two large dredges, which at times during the year was increased to three dredges.

The quantity removed during the year was 509,867 cubic yards. The Bay Ridge Channel is now 375 feet wide and 21 feet deep from Twenty-eighth street to Forty-second street, South Brooklyn. The contract will be completed, it is expected, August 1, 1894.

The amount expended on this channel during the fiscal year ending June 30, 1894, inclusive of outstanding liabilities, was $76,675.97.

The low prices at which work is being done under existing contracts will materially diminish the estimated cost of the project. The appropriation made by act of July 13, 1892, will complete the projects for the Red Hook, Gowanus Creek, and Bay Ridge channels, but will not provide for the removal of the triangular area lying between them at the entrance to the bay.

The work remaining to be done, if no large shoaling has taken place in the improved channels, calls for the removal of 500,000 cubic yards of material, at an estimated cost of $125,000, approximately, including expenses of engineering and inspection.

The sum of $125,000 is recommended for the fiscal year ending June 30, 1896, for application in completing the existing project for improvement.

Gowanus Bay is in the collection district of New York. Nearest light, Robbins Reef. Nearest work of defense, the fort on Governors Island, 1 mile to the northward.

Amounts appropriated.

Application.	Date.	Amount.
Dredging	Mar. 3, 1881	$40,000
Do	Aug. 2, 1882	20,000
Do	July 5, 1884	5,000
Do	Aug. 5, 1886	7,500
Do	Aug. 11, 1888	60,000
Do	Sept. 19, 1890	160,000
Do	July 13, 1892	198,600
Total		491,100

Amount expended to June 30, 1894, inclusive of outstanding liabilities..$425,278.07

Money statement.

July 1, 1893, balance unexpended		$198,795.91
June 30, 1894, amount expended during fiscal year		110,892.34
July 1, 1894, balance unexpended		87,903.57
July 1, 1894, outstanding liabilities	$22,081.64	
July 1, 1894, amount covered by uncompleted contracts	56,487.27	
		78,568.91
July 1, 1894, balance available		9,334.66

Amount (estimated) required for completion of existing project	281,400.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	125,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

COMMERCIAL STATISTICS.

The commercial statistics for the fiscal year ending June 30, 1890, have remained practically unchanged, and are therefore herein repeated.

[For the year ending December 31, 1889.]

Receipts and shipments.

Articles.	Quantity.	Value.
Coal ... tons..	687,000	$2,748,000
Brick ... number..	202,000,000	1,414,000
Lumber ... feet, B. M..	147,000,000	2,940,000
Lime, etc ... barrels..	460,000	690,000
Grain ... bushels..	2,750,000	1,100,000
Ice ... tons..	230,000	805,000
Roofing tar ... barrels..	75,000	225,000
Building stone, etc	....	647,000
Miscellaneous	....	2,500,000
Total	....	13,069,000

Vessels arriving and departing below Hamilton avenue bridge.

Class.	Number.	Tonnage.
Steamers	46	33,211
Ships	68	105,741
Barks	489	441,614
Brigs	56	17,627
Schooners	231	57,392
Total	890	655,585

Vessels arriving and departing above Hamilton avenue bridge (record of bridge-tender).

	Times opened and closed.	Vessels passed through.	Registered tonnage.	Daily average of times opened.
June 1, 1889, to May 31, 1890	8,624	7,668	1,430,664	28
1886	7,632	6,071	985,431	21
Increase	992	1,597	445,233	7

Classification of vessels.

	Number.	Registered tonnage.	Draft.
			Feet.
Schooners	1,393	172,738	6 to 12
Sloops	972	62,925	6 to 10
Barges	1,625	409,486	6 to 8
Canal boats	3,678	785,515	6 to 8
Total	7,668	1,430,664	....

The increase in value of receipts and shipments compared with 1887 is $749,000. It is believed that the values as stated in 1887 are too large, and that the true increase is very much larger.

BAY RIDGE CHANNEL.

[These statistics are not included in the previous table.]

Receipts and shipments.

Articles.	Value.
Asbestos cement, paint, and roofing	$2,225,000
Brick and lumber	350,000
Export sugar machinery and castings	175,000
Petroleum and its products	3,300,000
Phosphates	350,000
Ship and yacht building, dry docks, machine and boiler works, and other industries	1,000,000
Total	7,400,000

There are large factories and piers building along the line of the channel, which will enhance the tonnage and values.

Of larger vessels, such as ships, barks, etc., about 300 have been at the docks. From observation it is estimated that there are about 1,200 of smaller craft.

E 10.

IMPROVEMENT OF NEW YORK HARBOR, NEW YORK.

New York Harbor is the name applied to the waters surrounding the city of New York, comprising parts of the Hudson, East, and Harlem rivers, and the Upper and Lower bays, lying, respectively, inside and outside of the Narrows and between the Long Island, Staten Island, and New Jersey shores.

The city of New York, from which the harbor takes its name, lies at the mouth of the Hudson River at its junction with the East River, and with the adjacent cities of Brooklyn and Jersey City, which are but the natural outgrowths of New York energy and enterprise, includes a population of nearly 3,000,000 inhabitants, which is more than the population of any State in the Union, excepting New York, Pennsylvania, Ohio, Illinois, and Missouri.

At this port two-thirds of the merchandise imported into the United States is received, and two-thirds of the import duties are collected. From this port are sent one-half of the domestic products of the country which are exported, and here one-half of the foreign tonnage trading with the United States enters. Three-fourths of the passengers traveling between the United States and foreign countries come and go by the way of New York, and three-fifths of all immigrants land at this port.

New York Harbor has two entrances, one by the East River and Hell Gate, leading into Long Island Sound, used chiefly by vessels trading between New York, the Eastern States, and British American Provinces; the other, which is the main entrance, leading out through the Narrows, by Sandy Hook, directly into the Atlantic Ocean, and used by all the transatlantic steamers and vessels.

The Hell Gate entrance has been in course of improvement since 1869, and with its successful completion—which is now assured within a few years—and with the steady growth of the city toward the north it must come more than ever into use by foreign-bound vessels.

The main or Sandy Hook entrance into New York Harbor is one of the best in the world. The channel prior to 1884 was less than 24 feet deep at mean low water, and nearly 29 feet at mean high water, with abundant breadth, and was ample for all the commercial requirements of the port until the great increase in the length, tonnage, and draft of the transatlantic passenger steamers made further deepening necessary in order to prevent the delays to which they were subjected by having to wait for high water in order to pass either in or out.

Before the improvement of the Main Ship Channel into New York Harbor was undertaken by the United States it was obstructed by four shoals, as follows:

1. The outer bar, about 4,000 feet wide, the channel across which is known as Gedney Channel, where there were depths of 23.7 feet in mid-channel and 22.3 feet in the southern half.

2. The shoal at the mouth of the Swash Channel, about 4,000 feet wide, where the depth was 24.3 feet.

The channel across this shoal has been named the Bayside Channel.

3. The shoal northwest of Sandy Hook, about 2,000 feet wide, on which the least depth was 26.2 feet.

4. The shoal in the Main Ship Channel in the Lower Bay, west of Flynn Knoll, nearly 3 miles long, on the crest of which the depth was only 23.9 feet in mid-channel, with depths of 22.6 feet within a few hundred feet of the mid-channel range.

A large proportion of the vast commerce of the port, which was carried on in vessels of great draft, could only cross these shoals at or near high water.

The reasonable demand which had been made in 1884 by commercial bodies residing in New York City, that increased facilities should be afforded for entering the port of New York by the Sandy Hook route, was recognized in the river and harbor act of July 5, 1884, which provided for "deepening Gedney Channel through Sandy Hook Bar, New York, $200,000."

A few words upon the subject of the lower harbor and of the various channels across the bar at the entrance are here necessary for a proper understanding of the causes which led to the adoption of the Main Ship Channel for improvement.

Gedney Channel is the main channel across the ocean bar, lying at the entrance to New York Harbor, about 3 miles outside of Sandy Hook, and east by north of it. Sandy Hook lies about 9 miles outside of and nearly south from the Narrows, which is the name given to the strait separating the nearest points of Long Island and Staten Island; and the Narrows, in turn, are about 7 miles south from the Battery at the extreme southern end of Manhattan Island, upon which New York is situated. The Narrows are about 1 mile wide. That part of New York Harbor lying outside of the Narrows is commonly known as the "Lower Bay."

From the Narrows northward to New York City there is no water less than 6 fathoms (36 feet) deep in the main channel.

Lower Bay is a large tidal basin, with an area of about 100 square miles, estimating inside or northward and westward of a line drawn from Sandy Hook to Coney Island.

The western end of the bay formed by Sandy Hook, the adjacent Jersey shore, and Staten Island, is known as Raritan Bay, and the southern part of it inside the peninsula of Sandy Hook is known as Sandy Hook Bay, or more commonly as the Horseshoe.

From the northwest around by the east to south-southeast the Lower Bay is open to the full sweep of the Atlantic Ocean.

From the Narrows to the northern point of Sandy Hook is about 9 miles, but the shortest distance across the bay from the point of Sandy Hook to Coney Island is 7 miles. The water cross section on this line at mean low water is about 790,000 square feet, through which the mean velocity is approximately 1.6 feet per second; but the maximum velocities are approximately twice as great. (Board of Engineers' Report for 1884.)

At the Narrows the channel is about 1 mile wide and 70 feet deep, with depths in it of over 100 feet.

Below the Narrows there is one main channel, commonly known as the Main Ship Channel, running southward to a point about 1 mile west of the upper end of Sandy Hook; thence turning at right angles northward and eastward for 4 miles to the head of Gedney Channel, and thence through Gedney Channel east to the deep waters of the ocean.

But along and inside the above-mentioned cross section, 7 miles, between Sandy Hook and Coney Island, there is a wide shoal with five distinct channels of varying depths running through it seaward and eastward.

They lie in the following order, beginning at the northward:

(*1*) *The Coney Island Channel.*—In which the navigable depth at mean low water is 10 feet.

(*2*) *The Fourteen-foot Channel.*—In which the navigable depth at mean low water is 15 feet.

(*3*) *The East Channel.*—In which the navigable depth of water is 19 feet.

(*4*) *The Swash Channel.*—Through which 22 feet can be carried at mean low water in a narrow channel.

(*5*) *The Main Ship Channel.*—In which, prior to 1885, 24 feet only could be carried through different reaches with lumps in them, over which the depth was only 23.3 feet at mean low water. The northern reach, which passes along the west side of Flynn Knoll, is maintained by tidal flow through the Narrows; and the southern reach, along Sandy Hook, is maintained by tidal flow through Raritan Bay.

These five channels are separated by shoals with from 4 to 18 feet of water over them at mean low water.

The first three of these channels head directly out into the open sea; but the two latter converge into an area of about 2 miles square, lying north and east of Sandy Hook, which has a depth in it of 30 feet of water and over, and from this deep area two channels lead eastward into the open sea over the outer bar, the northernmost known as Gedney, the southernmost as the South Channel, both of which had, prior to 1885, only 24 feet of water in them at low water. Gedney Channel, the wider, was originally the deeper and straighter of the two, and was therefore used by all the large vessels.

The Swash Channel is really a cut-off from the Main Ship Channel, leaving it about 6 miles below the Narrows, and joining it again at the western end of Gedney Channel.

Apart from being shoaler, the Swash is much narrower than the Main Ship Channel.

The distance from the Battery, at New York, to 30-foot soundings outside the bar in Gedney Channel is 22 miles, and by the Swash it is 18 miles, or from the Narrows 15 and 11 miles respectively.

As the appropriation of 1884 was made in advance of an approved project, the local officer was authorized and directed to make a survey of the Lower Harbor from the eastern end of Coney Island to Sandy Hook, with a view of determining the most feasible plan of improvement. The survey was completed in November, 1884, and a report recommending the improvement of Gedney Channel and the eventual improvement of the Main Ship Channel, accompanied with estimates of cost and chart, was submitted December 6, 1884. (Annual Report Chief of Engineers, 1885, p. 773.)

The navigation of the Main Ship Channel inside the bar, especially on the approach to the Narrows from the Southwest Spit, is so intimately connected with that of Gedney Channel across the bar, that it was deemed important in submitting an estimate of cost for the improvement of the latter channel directed to be made by Congress in the act of 1884, to extend the estimate to include the entire Main Ship Channel at Flynn Knoll and to recommend that the improvements at several intermediate shoals should take place simultaneously. The project providing for deepening the channel across the bar to 28 feet by dredging, and for the contingent construction of a stone dike on the north side of the harbor, which had been recommended by a board of engineers, December 24, 1884, received the approval of the Secretary of War December 27, 1884. (Annual Report Chief of Engineers, 1885, Part I, p. 774.)

The project under which the improvement began provided for improving the western end of Gedney Channel for a length of 4,000 feet, measured along its axis, and the Main Ship Channel, west of Flynn Knoll, from Buoy No. 10, at the western end of the Southwest Spit, north of Buoy No. 12, then situated 1½ miles south of the western entrance to Swash Channel, the depth to be 30 feet mean low water.

The cost was estimated at $970,000, not inclusive of any allowance for irregularities of cutting or for increase of bulk for scow measurements. After the work had progressed for one year, and these allowances could be estimated with some degree of accuracy, the estimate was revised, and the cost of executing the project as then approved was fixed at $1,370,000.

The river and harbor act of August 5, 1886, containing provisions for continuing the improvement at the entrance to New York Harbor, read as follows:

> Improving New York Harbor, New York: To secure a 30-foot channel at mean low water at Sandy Hook entrance of the harbor, upon such a plan as the Secretary of War may approve, $750,000.

By the specific wording of this act Congress gave an express approval of an improvement which contemplated a navigable channel 1,000 feet wide and 30 feet deep, mean low water, through the Main Ship Channel and Gedney Channel, and all subsequent acts have confirmed the provisions of the act of 1886.

In 1887 the project was enlarged so as to embrace a length of 4,500 feet in Gedney Channel, measured along the axis, or a length of 6,000 feet measured along the north side; to remove the shoal in the Main Ship Channel at the south entrance to the Swash Channel, afterwards called the "Bayside Channel;" to remove the shoal northwest of Sandy Hook, and to extend the Main Ship Channel north from Buoy No. 12 to and beyond the north entrance to the East Channel at Buoy No. 14 (now Buoy No. 10). The total estimated cost of the project so enlarged, based on the existing prices for dredging, was $1,490,000.

The river and harbor act of August 11, 1888, appropriated $380,000 for continuing the improvement.

The river and harbor act of September 19, 1890, appropriated $160,000 for continuing the improvement, making the total amount appropriated at that date $1,490,000, the total estimated cost of the improvement.

Operations for improving the Lower Bay under project to provide a navigable channel 1,000 feet wide and 30 feet deep mean low water, from the sea along Gedney Channel and the Main Ship Channel, were begun September 26, 1885, and completed October 10, 1891.

The plant which was used consisted solely of centrifugal pumps installed in steamers, and the excavations were all dumped at sea in 14 fathoms of water in the vicinity of the Scotland light-vessel. After the completion of the project the steam dredge last used by the contractors was purchased by the Government, and has since been used to trim banks and corners to facilitate navigation, and to provide means for maintaining the improved channel.

The quantities of material removed from the several reaches of the channels improved from September 26, 1885, to June 30, 1892, were as follows:

	Cubic yards.
From Gedney Channel	1,161,244
From Bayside Channel	448,313
From Northwest Shoal	118,758
From west of Flynn Knoll	3,146,764
Total quantity excavated	4,875,079

SHORE PROTECTION AT SANDY HOOK, N. J.

The protection of the eastern and northern shores of Sandy Hook, composed of irregular sand dunes, against wave and current action forms part of the project for improvement of the Main Ship Channel through the lower harbor, but as the work required to be done there was necessarily tentative, it was deemed best to limit expenditures to small sums of money annually while studying the most economical plan of improvement.

Sandy Hook, like the more southerly part of the coast of New Jersey, where the foreshore is a long, submerged shoal, has had a varied experience in changes of form and extent resulting from tidal and current action, supplemented by wave action during storms.

The eastern shore along False Hook Channel is a long, unbroken beach, remarkably uniform in its contours, and, as it is under the cover of the outlying shoals, has undergone few changes either of accumulation or degradation.

From the northwest corner of the Spit, where the outer shoal has diminished width, westward around the Hook to beyond the Hook Beacon, the north shore is open to northerly and easterly storms, and is particularly subject to frequent changes, and it is on this front that the shore protections have been laid.

The great ravages made there by the sea in 1863 made shore protection an immediate necessity, and during the next twenty years many points were protected along the crown of the Hook from east to west, the improvements taking the form of jetties extending out, at varying angles, with the shore line from near high-water to below low-water mark.

The Main Ship Channel hugs this shore, and the water, at a distance of less than 2,000 feet, has a depth of over 60 feet. The slope of the foreshore is somewhat steep; and as the main object of the improvement was to preserve the high-water line and the dunes behind it, there being no marked tendency of the currents to cut below the low-water line, it was thought best to place the outer ends of the jetties near the latter curve. To have anchored the jetties in deep water, under the circumstances, would have been unjustifiably expensive.

Some of the jetties were built of timber, some of timber, brush, and broken stone, and others of concrete, either in bags or in forms. In 1883–'84 the timber jetties, which were in a state of decay, were wholly replaced by concrete, built in place and arranged in sections 10 feet long, so that when undermined, either at the ends or on the sides, settlement would be by sections, without fracturing the body of the jetty.

The cement used was a brand of American Portland. The general cross-section area of the jetties was 50 square feet. While these jetties served to cover a certain part of the shore line for certain winds, it was noticed that they gave no protection to the high-water line during storms from any direction which were coincident with spring tides. In the latter case, no matter what the direction of the wind, the cliffs at or near the high-water mark were attacked and degraded by the waves.

To prevent the complete destruction of the cliffs and to arrest the recession of the high-water line before the foundations of the defenses and other public buildings were reached it was decided in 1890 to run a riprap wall just below the high-water line completely around the Hook, uniting all the jetties.

The work which was begun in May, 1890, was continued to completion in September, 1891. The wall is 2,575 feet long, extending from Jetty No. 1 to about 119 feet westward of Jetty No. 11 and had a cross section when first laid of 50 to 60 square feet.

The stones vary in weight from 300 pounds to 3 tons and are laid directly upon the beach, with the purpose that each stone shall arrange its bed at once after the sea attack, allowing a gradual settlement of the wall without sudden dislodgment of the stone. The cost was $6 per running foot of wall.

During the past four years the whole wall has settled gradually, with very little lateral displacement of stone, but it has perfectly shielded the cliffs during the northerly and easterly storms, while the jetties have caused the beach pockets to fill up during the intervals of southerly seas, causing the low-water line to move outward. As the result of the improvement the beach is gradually building up and the high-water line is moving outward.

The amount expended upon this protection to June 30, 1893, aggregated $19,095, and the cost, including repairs for settlement, was $7.41 per running foot of wall.

A survey made in June, 1893, showed that the Hook had moved to the westward 250 feet during the year 1893.

WORK DONE DURING THE FISCAL YEAR ENDING JUNE 30, 1894.

No contract was in force at the beginning of the year, as the work of improvement was carried on by hired labor, employing the U. S. steam dredge *Gedney*, which was purchased in 1892.

The river and harbor act of July 13, 1892, appropriated $170,000 for continuing the improvement.

The project for the expenditure of this appropriation, approved by the Chief of Engineers July 20, 1892, provided for the purchase of the steamer for the sum of $72,500, and for its employment as follows:

(1) Widening to 2,000 feet south entrance to Main Ship Channel west of Buoy No. 12, at the western end of Southwest Spit, the turning point for passing from the deep-water channel north of Sandy Hook (Bayside Channel) to the channel leading northward toward the Narrows.

(2) Swash Channel, by cutting off projecting points on west side, westward of Romer Beacon, and removing isolated lumps in mid-chan-

nel so as to afford a channel whose least width shall be 600 feet and least depth 26 feet at mean low water.

(3) Removal to the depth of 26 feet at mean low water of Craven Shoal, lying near the west bank of the upper channel, opposite quarantine station, south of the Narrows.

After six months' work, terminating about the 1st of June, 1893, at the southern entrance to Main Ship Channel at perch and ball red buoy No. 12, resulting in the enlargement of the entrance to a width of 1,500 feet, the vessel was transferred early in July to the southern end of the Swash Channel, where work was begun to cut down to 26 feet, mean low water, all the shoals which projected into the channel from the west side, enabling coastwise vessels to make the south channel more directly, and to increase facilities for entering and leaving the Swash.

In December the boat was sent to Gedney Channel to trim both banks near the western end, where shoal areas were left on previous suspension of work, and in February like operations were performed on the northern bank of the Bayside Channel, a little to the eastward of the entrance to the Swash. March 1 the vessel was laid up for repairs, and when again put in commission operations were resumed on the project for widening the southern entrance to Main Ship Channel, at turning buoy No. 12.

The steam dredge gives satisfactory results. While at work in Gedney Channel, the best record for any one day was 3,771 cubic yards, and the average record was 2,596 cubic yards; in Bayside Channel the average return was 2,871 cubic yards; in Swash Channel the average return was 2,202 cubic yards; and in Main Ship Channel, at buoy No. 12, Southwest Spit, the average return was 1,229 cubic yards. The net return per day diminishes as the distance to the dumping ground increases.

The net cost per cubic yard for the year was 11.9 cents, including expenses of every kind incurred. The work done during September, October, and November cost only 6.9 cents per cubic yard, and the average cost during the year was 8.7 cents, based on the monthly running expenses of the steamer, exclusive of general repairs. The price paid under the last contract was 23.9 cents per cubic yard.

The annual running expenses of the steamer, including wages of crew, coal, supplies, repairs, office expenses, and surveys, were $65,800.47. The amount available at the close of the fiscal year is $17,743.14.

Mariners have made no complaint during the year that the channel has not adequate depth of water. On the contrary, a most gratifying testimony to the satisfactory condition of the channel over the bar was given recently by one of the steamship companies of this port, employing some of the largest and finest steamers in the transatlantic traffic, in the adoption of a regulation designating a certain fixed hour in the day for the departure of its steamers from port, regardless of the stage of the tide at the time.

If this regulation is continued in force no further proof is needed of the success of the improvement.

The survey of the Main Ship Channel made by this office during August and September indicates that the improved depths have not only been well maintained, but that there are evidences of slight deepening throughout this channel.

While this survey was in progress a severe storm arose during the night of August 24, which caused the sinking of the U. S. steamer *Gen. A. A. Humphreys*, lying at her dock at Atlantic Highlands, and the dismantling of the U. S. schooner *Brenda* by collision with the yacht *Telfer*.

The steamer *Gen. A. A. Humphreys* was raised by the use of the U. S. dredge *Hell Gate*, and was subsequently repaired by authority of the Chief of Engineers, September 2, 1893.

No work was done during the fiscal year on the sea wall and jetties built for the protection of the north shore of Sandy Hook, except the supply of 1,500 tons of large stone, which were put in place to strengthen the wall to the eastward of the shore beacon, at an aggregate cost of $4,141.78.

The wall and jetties continue to give satisfaction in protecting the shore against sea erosion.

The western point of the Hook has extended 120 feet to the westward during the year.

Authority was granted by the Chief of Engineers June 6, 1894, to expend the sum of $2,000 for the protection of the beach in front of the Pneumatic Gun Site, about 800 feet west of the extreme western jetty. When the pneumatic guns were located on this site, in June, 1889, it was well inland, but the change in the shore line of Sandy Hook, where unprotected, has been so great as to actually attack the foundations of the guns.

A construction track and power-derrick car have been prepared, and 1,000 tons of large stone purchased under sealed proposals, dated June 18, 1894, at a cost of 56½ cents per ton.

Delivery of stone began June 27, 1894, and the work is under way. It is proposed to build the riprap wall in front of the gun site, just below the high-water line, in a manner conformable to the plan pursued in building the other shore protection, as it is intended later to carry the wall easterly to connect with the western end of the existing wall at the beacon.

The amount expended on the improvement of New York Harbor during the fiscal year ending June 30, 1894, inclusive of outstanding liabilities, was $70,964.63.

An appropriation of $150,000 is recommended to provide running expenses of the steam dredge *Gedney* for two years.

The operations in and about New York Harbor have been supervised by Mr. G. W. Kuehnle, assistant engineer, to whom I am indebted for the most satisfactory and intelligent service rendered in the discharge of his various trusts.

The work is in the collection district of New York. Nearest light-houses Sandy Hook and Highland lights. The nearest forts are the fort at Sandy Hook and those at The Narrows.

AMOUNTS APPROPRIATED.

For Gedney Channel, by act July 5, 1884	$200,000.00
For New York Harbor:	
Act August 5, 1886	750,000.00
Act August 11, 1888	380,000.00
Act September 19, 1890	160,000.00
Act July 13, 1892	170,000.00
Total	1.660,000.00
Amount expended to June 30, 1894, inclusive of outstanding liabilities	1,642,256.86

Money statement.

July 1, 1893, balance unexpended	$88,707.77
June 30, 1894, amount expended during fiscal year	67,744.39
July 1, 1894, balance unexpended	20,963.38
July 1, 1894, outstanding liabilities	3,220.24
July 1, 1894, balance available	17,743.14

Amount that can be profitably expended in fiscal year ending June 30, 1896 $150, 000. 00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

COMMERCIAL STATISTICS.

The commercial statistics for the fiscal year ending June 30, 1890, have remained practically unchanged, and are therefore herein repeated.

The following statement concerning the commerce of New York Harbor is taken from the Report of the Chamber of Commerce of the State of New York for the year 1889-'90:

Articles.	Imported.		Exported.		Total value.
	Quantity.	Value.	Quantity.	Value.	
Sugar .... pounds..	1, 463, 051, 343	$42, 943, 453	....	....	$42, 943, 453
Molasses .... gallons..	8, 498, 875	1, 424, 251	....	....	1, 424. 251
Coffee .... pounds..	455, 979, 016	58, 860, 319	....	....	58, 860. 319
Tea .... do....	58, 476, 531	9, 643, 514	....	....	9, 643. 514
Manufactures of wool, silk, cotton, and flax	....	111, 234, 883	....	$7, 728, 397	118, 963, 280
Cotton .... pounds..	....	....	536, 614, 045	54, 701, 315	54, 701. 315
Leather and hides	....	25, 760, 160	....	4, 906, 214	30, 666. 374
Tin .... pounds..	327, 279, 151	14, 825, 588	....	....	14, 825. 588
Raw silk and wool .... do....	5, 505, 689	13, 949, 577	....	....	13, 949, 577
Hemp, jute, sisal grass, etc.. tons..	149, 263	13, 431, 215	....	....	13. 431, 215
India rubber and gutta-percha, crude .... pounds.	28, 652, 361	11, 094, 063	....	....	11, 094, 063
Tobacco, and manufactures	....	10, 147, 883	....	15, 291, 084	25, 438, 967
Furs, and manufactures	....	4, 748, 971	....	4, 724, 017	9, 472, 988
Earthen, stone, and china ware	....	3, 230, 780	....	....	3. 230, 780
Wines	....	6, 156, 821	....	....	6, 156, 821
Coin and bullion	....	7, 274, 618	....	69, 724, 274	76, 998, 892
Precious stones	....	9, 498, 209	....	....	9, 498, 209
Miscellaneous	....	135, 203, 820	....	75, 006, 102	210, 209, 922
Breadstuffs:					
Wheat .... bushels..	....	....	9, 066, 407	8, 449, 510	8. 449. 510
Wheat flour .... barrels..	....	....	3, 335, 195	15, 498, 193	15. 498, 193
Corn .... bushels..	....	....	26, 658, 970	13, 066, 961	13, 066, 961
All other breadstuffs	....	....	....	1, 765, 287	1, 765, 287
Provisions .... pounds..	....	....	753, 007, 846	64, 504, 425	64, 504, 425
Mineral oils .... gallons..	....	....	418, 773, 072	36, 049, 956	36. 049. 956
Cattle	....	....	75, 004	6, 204, 624	6, 204, 624
Oil cake and meal .... pounds..	....	....	231. 034, 183	3, 032, 066	3, 032, 066
Foreign merchandise	....	....	....	16. 727, 560	16, 727. 560
Total	....	479, 428, 125	....	397, 379, 985	876, 808, 110

This table shows an increase of $24,642,419 over the total value of imports and exports for the preceding year, which amounted to $852,165,691.

Commercial statistics of the port of New York from July 1, 1893, to July 1, 1894.

Amount of revenue collected	$87, 849, 487. 58
Value of all imports	415, 795, 991. 00
Value of all exports	369, 146, 365. 00

	Number.	Registered tonnage.
Foreign vessels entered	3, 508	6, 006, 658
Foreign vessels cleared	3, 607	5, 955, 391
American vessels from foreign ports	1, 038	1, 064, 423
Coastwise vessels entered	2, 371	2, 890, 930
Coastwise vessels cleared	2, 440	2, 978, 227

Statement of the number and tonnage of all vessels belonging to the port of New York, July 1, 1894.

	Number.	Registered tonnage.
Steam vessels	1,060	446,994.77
Sailing vessels	1,124	278,043.44
Barges	604	132,200.45
Canal boats	33	6,058.01

E II.

IMPROVEMENT OF JAMAICA BAY, NEW YORK.

Jamaica Bay is a tidal bay, situated on the south side of Long Island near the western end, whose waters flow into the Atlantic Ocean through Rockaway Inlet.

Inside the entrance there is a deep-water basin, from which one navigable channel leads to the northward in the direction of Canarsie, and another, called Beach Channel, to the eastward, behind Rockaway Beach, in the direction of Far Rockaway. From the eastern terminus of one of the branches of the latter channel, which passes through Conch Hole, an artificial cut into Far Rockaway Bay was made several years ago by citizens to enable small boats to pass eastward through that bay into Hempstead Bay and beyond.

The river and harbor act of September 19, 1890, contained provision for a survey "from Main Channel from Jamaica Bay easterly to Long Beach Inlet, for canal."

The usual preliminary examination was made according to law, and the local officer stated in his report, dated December 16, 1890 (Annual Report Chief of Engineers, 1892, p. 840), that in his judgment the western part only of the waterway mentioned in the act, extending from the main ship channel, Jamaica Bay, easterly through Conch Hole, to the Citizens Cut at Far Rockaway, was "worthy of improvement," to the extent of opening a connecting channel 60 feet wide, affording 5 feet depth at mean low water.

A survey of the bay was authorized to be made, and a report was submitted thereon October 29, 1891 (Annual Report Chief of Engineers, 1892, p. 845), which gave estimates of cost for the opening of a new waterway across the eastern part of the bay 60 feet wide and 5 feet deep, mean low water, following three different routes, viz:

(1) From Conch Hole to western end of Citizens' Cut	$21,406
(2) From entrance to Bass Channel to Citizens' Cut	18,920
(3) From entrance to Bass Channel to foot of Bayswater avenue, Far Rockaway	9,460

The river and harbor act of July 13, 1892, appropriated $9,460 for "completing improvement in accordance with plan numbered 3, of Lieut. Col. Gillespie, Corps of Engineers, submitted December 16, 1890."

This is the first appropriation ever made for the improvement of the eastern part of Jamaica Bay.

WORK DONE DURING THE FISCAL YEAR ENDING JUNE 30, 1894.

At the beginning of the fiscal year the contract with Elijah Brainard, dated October 13, 1892 (Annual Report Chief of Engineers, 1893, Part I, p. 1069), was still in force.

Operations under this contract continued until September 20, 1893, at which date the contract was completed. The quantity of material removed during the fiscal year was 20,174 cubic yards, and the total amount removed under this contract was 34,019 cubic yards, resulting in a channel 60 feet wide and 5 feet deep, mean low water, to within 400 feet of the bulkhead at the foot of Bayswater avenue.

No appropriation is recommended for the fiscal year ending June 30, 1896, as the appropriation made by the river and harbor act of July 13, 1892, was for the full amount estimated to be required for the completion of the project.

Jamaica Bay is in the collection district of New York. The nearest fort is at Fort Hamilton, Gravesend Bay, and the nearest light-house is located upon Norton Point, Coney Island, New York Bay.

Amount appropriated, act of July 13, 1892	$9,460
Amount expended to June 30, 1894	9,460

Money statement.

July 1, 1893 balance unexpended	$8,091.85
June 30, 1894, amount expended during fiscal year	8,091.85

COMMERCIAL STATISTICS.

The amount of commerce which it is alleged will be benefited by the improvement has been estimated at 500,000 tons. The vessels which now navigate the eastern part of Jamaica Bay are usually of the class engaged in the oyster trade, and number 100 probably. A larger class of boats may be drawn into the trade on the completion of the project for improvement.

E 12.

IMPROVEMENT OF RARITAN BAY, NEW JERSEY.

Raritan Bay forms the western part of the large triangular bay inclosed between Sandy Hook, the New Jersey shore, and Staten Island, the eastern part of which is commonly known to New Yorkers as the Lower Bay, as it lies just outside of or below New York Harbor, which is the name usually applied to the inner body of water on which the city of New York is situated.

The Raritan River flows into Raritan Bay at its extreme western end, passing between Perth Amboy and South Amboy, and Newark Bay is connected with both the Raritan River and Bay by the Arthur Kill or Staten Island Sound, which, separating Staten Island, belonging to the State of New York, from the New Jersey shore, enters Raritan Bay at Perth Amboy.

The depth of the bay varies from 5 to 30 feet, decreasing gradually toward its western and southern shores.

The natural channel leading out of it toward the eastward after passing the Great Beds Light at the junction of Staten Island Sound and the Raritan River does not follow the middle of the bay, but hugs the Staten Island shore for nearly 4 miles to Seguine Point, situated about half a mile east of Princess Bay Light, then it runs southeastwardly toward the inner point of Sandy Hook about 2 miles, crossing a shoal which puts out toward the southward from the Staten Island shore.

In 1880, before any improvement had been made here by the Government, 18 feet at mean low water could be carried through from Perth Amboy to Great Beds Light, 21 feet from Great Beds Light to Seguine Point, and 14½ feet from Seguine Point eastward across the shoal to the deep water in the outer bay.

The width of this shoal between the 21-foot curves was about 8,000 feet.

Through the middle of the bay, south of this channel from Great Beds Light directly toward Sandy Hook, only 11 feet of water could be carried over the shoals.

The above depths all refer to mean low water.

A survey of this bay was ordered in 1880 with the view of ascertaining the practicability of securing a greater depth of water from the main ship channel, in the lower bay, to the wharves at Perth Amboy, as vessels were often much delayed in crossing the shoal east of Seguine Point.

The estimated cost of dredging a channel 300 feet wide and 21 feet deep, mean low water, from Seguine Point southeastward to the deeper waters of the bay outside, was $126,500. (Annual Report Chief of Engineers, 1881, Part I, pp. 717–719.)

From March 3, 1881, to July 5, 1884, $120,000 was appropriated for this improvement, and a survey which was made in May, 1885, showed that the improved channel at that date had an average width of 250 feet and a least depth of 18 to 20 feet mean low water.

In 1885 the project was extended by providing for excavating a channel 300 feet wide and 21 feet deep from Great Beds Light to deep water at Ward Point, opposite to Perth Amboy. This channel, taken in connection with its extension to the eastward of Seguine Point, would give a continuous 21-foot channel from the main ship channel in New York Bay to the wharves at Perth Amboy. The modified project of 1885 further called for dredging a channel from Great Beds Light to South Amboy, 4,500 feet long, 300 feet wide, and 15 feet deep, mean low water. The cost of dredging these two channels and restoring the original width in the cut east of Seguine Point was estimated at $114,000, which sum was increased in 1888 to $120,000 to provide for the shoaling which had taken place in the interval of three years. (Annual Report of the Chief of Engineers, 1885, Part I, p. 758.)

The appropriation, act of August 5, 1886, was $37,500, and was applied to completing the channel west of Ward Point, 300 feet wide and 21 feet deep, and in excavating a channel 315 feet wide and 21 feet deep across the crest of the shoal leading from the bend toward Seguine Point, but the funds were not sufficient to complete the whole of the projected work at that point.

It was stated in the original project of 1881 that the Seguine Point Channel would have to be maintained by dredging. The detailed survey, which was made in 1888 from the eastern end of Seguine Point Channel to Perth Amboy, showed that considerable shoaling had taken place, both in the improved channel and over a large stretch west of Princess Bay Light, where deep water formerly existed. This fact made it necessary in 1889 to submit revised estimates for the further improvement of the channels leading to Perth Amboy and to South Amboy. (Annual Report Chief of Engineers for 1889, Part I, p. 796.)

Revised estimates.

	Cubic yards
(1) For a channel 300 feet wide and 21 feet deep, mean low water, from New York Lower Bay to Perth Amboy, the following dredging will be required:	
(*a*) From 21-foot curve, New York Lower Bay, to 21-foot curve off Seguine Point	347,368
(*b*) From Princess Bay, around Red Buoy 8, toward Great Beds Light.	154,130
Total dredging	501,498
(2) For a channel 300 feet wide and 15 deep, from Great Beds Light to South Amboy, the dredging required will be	200,000

These estimates are made on the basis of an allowance of 1 foot over-depth and for one-third increase in bulk for scow measurements.

Total dredging required for the completion of the two projected channels, cubic yards	701,498
Estimated cost of the proposed dredging	$175,375

The river and harbor act of August 11, 1888, appropriated $25,000 for continuing the improvement, and on the 27th of February, 1889, contract was made for the removal of 120,000 cubic yards of material from Raritan Bay; 80,000 cubic yards to be removed from the channel across the shoal off Seguine Point, securing 21 feet depth, and 40,000 cubic yards from the channel leading across shoal at Great Beds Light to South Amboy, securing 15 feet depth, mean low water.

The river and harbor act of September 19, 1890, appropriated $40,000 for continuing the improvement.

It may be noted in regard to this improvement that the deep-water channel which has been said to hug the south shore of Staten Island as far east as Seguine Point is the *ebb* channel, while the channel on the southern border of Round Shoal, through the center of the bay, heading on the line joining Seguine Point, north shore, and Conaskonk Point, south shore, is the *flood* channel. These two channels slightly overlap, passing each other at a distance of 7,000 feet.

The connection of these channels by an improved channel starting at Seguine Point and running southeast toward Sandy Hook is an unnatural connection, and it was stated in the original report in 1881 that the channel so projected would require annual dredging for its maintenance.

The experience of all the contracts which have been made for this improvement confirms the prediction of 1881. It would have been better, had sufficient funds been available in the beginning, to have extended the flood channel by dredging almost due west until it intersected the ebb channel a short distance to the eastward of the Great Beds Light. Then the ebb and flood would have probably followed the same path, and there would have been a better prospect of having the channel maintained by tidal scour.

The width of the intervening shoal is about 12,000 feet, and the average depth of water is 13 feet, approximately, between the 21-foot curves.

This will be the future channel which will connect the head of the Raritan Bay with the Amboys. A limited amount of dredging may be done annually in the Seguine Point Channel to maintain a 21-foot depth for vessels until commerce demands a more direct and convenient route across the shoal now lying at the western end of the bay.

The appropriation of $40,000, act of September 19, 1890, was applied toward the improvement of the Seguine Point Channel and the South Amboy Channel. The contract for the former was completed September 24, 1891, and the channel was then 180 feet wide and 21 feet deep, mean low water. The contract for the latter was completed July 8, 1891, and the channel was then 170 feet wide and 15 feet deep at mean low water.

The river and harbor act of July 13, 1892, appropriated $40,000 for continuing the improvement of the two channels, the South Amboy Channel being then 170 feet wide and 15 feet deep at mean low water, and the Seguine Point Channel 180 feet wide and 21 feet deep.

The work was let to contract October 6, 1892, which provided for the removal of 83,000 cubic yards from the South Amboy Channel and 105,000 cubic yards from Seguine Point Channel. The project for the former was completed May 13, 1893, at which date the channel was 300 feet wide and 15 feet deep. Work was begun upon the Seguine Point Channel May 22, 1893, and was in progress at the close of the fiscal year ending June 30, 1893.

WORK DONE DURING THE FISCAL YEAR ENDING JUNE 30, 1894.

At the opening of the fiscal year work was in progress under contract with Mr. Thomas Potter, October 6, 1892, for the removal of 105,000 cubic yards of material from the Seguine Point Channel. The contract was completed July 10, after the removal of 106,936 cubic yards.

At that date the channel from Seguine Point to the eastward was 250 feet wide and 21 feet deep, and the channel leading to South Amboy was 300 feet wide and 15 feet deep.

Work on the channel from Seguine Point westward to Ward Point was suspended June 15, 1888, at which time the width was 300 feet and the depth 21 feet at mean low water.

These late improvements have been of material benefit to commerce, especially to that coming out of the Raritan River from the Delaware and Raritan Canal. The parties interested in this latter commerce now claim that the depth in the South Amboy Channel should be increased to at least 21 feet at mean low water.

All the channels are subject to deterioration by deposits, the South Amboy Channel to a less degree than the others. Their maintenance therefore requires that frequent dredging should be done.

No complaint has been made by mariners during the year that the channels have not furnished adequate accommodations to shipping, except as has been stated in regard to South Amboy Channel.

The estimate of $95,000 recommended for the fiscal year ending June 30, 1896, will, if appropriated, complete the project of 1885, and if the improvement is to continue thereafter a new project and estimates will be required.

The amount expended during the fiscal year ending June 30, 1894, inclusive of outstanding liabilities, was $19,641.33.

This work is in the collection district of Perth Amboy, which is the nearest port of entry. Nearest light-house, Princes Bay. Nearest fort, at Sandy Hook, New Jersey.

Amounts appropriated.

Application.	Date.	Amount.
Dredging	Mar. 3, 1881	$50,000
Do	Aug. 2, 1882	50,000
Do	July 5, 1884	20,000
Do	Aug. 5, 1886	37,500
Do	Aug. 11, 1888	25,000
Do	Sept. 19, 1890	40,000
Do	July 13, 1892	40,000
Total		262,500

Amount expended to June 30, 1894, inclusive of outstanding liabilities.. $260,952.82

Money statement.

July 1, 1893, balance unexpended	$21, 188.51
June 30, 1894, amount expended during fiscal year	19, 641.33
July 1, 1894, balance unexpended	1, 547.18
Amount (estimated) required for completion of existing project	95, 375.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	95, 000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

COMMERCIAL STATISTICS.

The commercial statistics for the fiscal year ending June 30, 1890, have remained practically unchanged, and are therefore herein repeated.

The following statement of the commerce of South Amboy, N. J., and of Raritan River was prepared by Hon. D. C. Chase, Mayor of South Amboy, N. J.:

Receipts and Shipments.

Articles.	Quantity.
	Tons.
Products of the forest	33, 851
Products of quarries and mines	3, 020, 003
Animal products	16, 541
Agriculture	37, 557
Manufactures	417, 909
Mechanical and miscellaneous	320, 005
Total	3, 845, 866

Total value, $45,075,943.

Vessels arriving and departing.

Class.	Number.	Tonnage.	Draft (loaded).
			Feet.
Steamers	6, 038	359, 300	6 to 12
Barks	40	8, 800	8 16
Brigs	40	8, 800	8 16
Schooners	4, 138	248, 280	7 14
Sloops	1, 002	52, 210	5 7
Propellers	4, 028	280, 682	7½ 10
Barges and lighters	45, 838	2, 887, 794	7 16
Total	61, 124	3, 845, 866	....

The following statement of the commerce of Perth Amboy, N. J., for the year 1889 was received from Mr. James Donnelly, superintendent of the New Jersey division Lehigh Valley Railroad Company:

Lehigh Valley Railroad tonnage eastward and westward over the wharves for the year 1889.

[Gross tons.]

	Received.	Shipped	Total.
Coal piers.			
Coal		1,815,521	
Coke		3,058	1,818,579
Freight wharves.			
Grain		125,743	
Steel rails		34,052	
Pig iron	471	87,796	
Iron ore	86,194		
Lumber	33,207	875	
Fertilizer	106		
Clay		5,662	
Miscellaneous	5,867	7,732	387,705
United Refiners' Export Oil Company's wharf.			
Oil		60,867	60,867
Grand total			2,267,151

Number, tonnage, and draft of vessels.

	Number.	Tonnage.	Draft.
Vessels transporting coal.			*Feet.*
Steam	102	500 to 3,000	
Sailing	848	50 1,200	
Barges	311	500 1,200	
Boats	4,821	100 400	
Vessels transporting freight.			
Ocean steamers	10	1,500 3,500	19 to 23.5
Sailing vessels	181	500 1,200	15 18
Lighters	57	200 500	6 13
Canal boats	1,238	200 300	 6
Company's wharf.			
Barks and ships	59	500 1,500	15 18

E 13.

REMOVING SUNKEN VESSELS OR CRAFT OBSTRUCTING OR ENDANGERING NAVIGATION.

(*1*) *Steam tug Talisman.*—The steam tug *Talisman* was sunk in Gedney Channel at the southern entrance to New York Harbor, September 16, 1893, by being run into by the steamer *Delaware.* The length of the tug was 88 feet, beam 20.6 feet, depth 9.9 feet, and net tonnage 50 tons.

Sealed proposals for the removal of the wreck were opened December 4, 1893, and, with the approval of the Chief of Engineers, the work was awarded to Townsend & Johnston, at a cost of $850. The wreck was successfully removed by May 10, 1894.

(*2*) *U. S. Engineer dredge Flood Rock.*—The U. S. Engineer dredge *Flood Rock*, while at work on reef off Sunken Meadow, East River, was run into and sunk on December 23, 1893, by the ferryboat *Wiehawken*.

Sealed proposals for the removal of the wreck were opened January 31, 1894, and contract was entered into March 8, 1894, with John Austin, of Philadelphia, Pa., for raising and removing the wreck of the dredge *Flood Rock* for $4,270. This contract expired May 1, but, with the approval of the Chief of Engineers, it was extended to May 31, to June 30, and again to July 30.

(*3*) *Barge Milton.*—The barge *Milton*, with a cargo of coal, was wrecked on the north side of reef off Sunken Meadow, Hell Gate, East River, New York, on November 20, 1893. The cargo was removed by the owners, and several unsuccessful attempts were made to raise the vessel. On January 20, 1894, the barge slipped off into deep water adjacent to the reef. Two of her masts had been removed before she disappeared, and the remaining mast was broken off immediately above the deck by a charge of dynamite. The wreck lies in 85 feet of water, with 50 feet of water over her deck. During the coming season an attempt will be made to destroy the hull of the vessel, to prevent irregularities of the currents.

The total amount expended during the year upon removal of wrecks is $939.39.

Abstract of proposals for removal of wreck of U. S. steam dredge Flood Rock, in East River, New York, received in response to advertisement dated January 2, 1894, and opened January 31, 1894, by Lieut. Col. G. L. Gillespie, Corps of Engineers.

No.	Name and address of bidder.	Price bid— For purchase and removal of dredge.	Price bid— For raising of dredge and towing to designated spot.	Remarks.
1	John Austin, 710 Walnut street, Philadelphia, Pa.		$4,270	Lowest bid for raising dredge.
2	William Du Bois, 642 Mercy avenue, Brooklyn, N. Y.	$1,000		Bid much below value of dredge.
3	Chapman Derrick and Wrecking Co., 70 South street.		5,700	

E 14.

MODIFICATION OF HARBOR LINES ON WEST BANK OF HARLEM RIVER, NEAR WASHINGTON BRIDGE, NEW YORK.

CITY OF NEW YORK,
DEPARTMENT OF PUBLIC PARKS,
49 AND 51 CHAMBERS STREET,
Commissioners' Office, July 11, 1893.

SIR: By chapter 102 of the laws of 1893 of the State of New York, authority was given to the city of New York to construct a speedway along the westerly bank of the Harlem River northerly of One hundred and fifty-fifth street.

The department of public parks of the city of New York, now having the matter in charge and acting for the city of New York, has caused elaborate and minute surveys to be made of the premises by its engineers, and from which surveys it is clearly shown, and it seems advisable for all interests, that before the work of constructing the speedway shall be actually commenced that slight modifications should first be made in the bulkhead lines of the Harlem River between points some 500 feet southerly of High bridge and those at a similar distance northerly of Washington bridge, as established by the Harbor Line Board October 18, 1890, and subsequently approved by the Secretary of War.*

Having this matter under consideration, the park board, by resolutions adopted July 6, 1893, approved the report of its engineer, and designated the undersigned as its committee to present to you the subject-matter of modifying the location of the bulkhead lines on the Harlem River between the points above named, with the request that you will cause directions to be given to the Harbor Line Board to reconsider their former action so far as relates to the bulkhead lines of the Harlem River between the points named, and that the Board of Engineers be authorized to give the park board a hearing, and request it to report their findings to you at as early a day as may be convenient.

We have the honor to be, sir, yours, respectfully,

PAUL DANA,
GEORGE C. CLAUSEN.

Hon. DANIEL S. LAMONT,
Secretary of War.

[Second indorsement.]

OFFICE CHIEF OF ENGINEERS,
U. S. ARMY,
July 13, 1893.

Respectfully referred to the Harbor Line Board for New York Harbor and its adjacent waters for report.

The Board will give the commissioners of public parks of New York City a hearing on the subject of this petition.

THOS. LINCOLN CASEY,
Brig. Gen., Chief of Engineers.

[Third indorsement.]

THE NEW YORK HARBOR LINE BOARD,
New York City, July 27, 1893.

Respectfully returned to the Chief of Engineers, inviting attention to the accompanying report of the Board of this date.

HENRY L. ABBOT,
Colonel of Engineers, Bvt. Brig. Gen., U. S. A.,
President of the Board.

REPORT OF BOARD OF ENGINEERS.

HARBOR LINE BOARD,
New York City, July 27, 1893.

GENERAL: In accordance with instructions conveyed in your indorsement of the 13th instant upon the application of the department of public parks of New York City for a modification of the harbor lines on the west bank of the Harlem River north of One hundred and fifty-fifth street, the New York Harbor Line Board has given a hearing to a committee consisting of Messrs. Paul Dana and George C. Clausen, who fully explained the wishes of their department. A stenographic record* of this hearing accompanies this report, together with two maps* presented in explanation of the application.

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* See Annual Report Chief of Engineers, 1891, p. 958.

The Board appreciates the importance of a public line of travel connecting the streets of the city at the proposed point of starting with the district near Kings bridge. The city authorities urge also the advantages of a public driveway where no cross streets will interfere with high speed, and where the natural beauties of the surroundings will add to the attractions of a pleasure resort open to all. They also urged that the diminution of the proposed general width of the roadway at the Washington bridge from 100 feet to 40 feet would be dangerous to vehicles driven rapidly. The Board can not, however, fail to recognize that these advantages should not be obtained by seriously interfering with a greater public interest, the free navigation of the Harlem. One important object of the improvement of this river now in progress is to relieve the congested channel around the southern portion of the city from the transit of canal boats en route from the upper Hudson to Long Island Sound. The public journals of late have contained vigorous complaints against the passage of these tows as interfering with ferryboats and other vessels and endangering life in this crowded waterway. The general width of the navigable channel of the Harlem has been fixed at 400 feet, but at a part of the locality in question this width has been reduced already to 375 feet to avoid interference with vested rights on the east bank. This change in the project was advised unwillingly, as appears from the report of the Board of Engineers dated August 3, 1886, which contains the following language:

> The Board in its report dated June 2, 1886, declined to recommend the narrowing of the channel in the Harlem River opposite the Ogden estate to 350 feet or to move the 400-foot channel 50 feet to the westward, as the first project would unduly narrow the channel and the second would materially increase the expense of the work.
>
> While any diminution in width is undesirable, should it be considered advisable to modify the original plan for the purpose of avoiding tedious litigation and hastening the commencement of the work, and since a more favorable landing place would be obtained, it can be done.
>
> The reduction in width at this point to 375 feet will not offer any serious inconvenience, as the formation of the western bank will not admit the construction of wharves and landing places. The eastern side only can be encumbered with vessels discharging cargo.

In studying the project now before us, which has the approval of the city authorities and is therefore entitled to much weight, the Board has endeavored to reconcile as far as possible the two conflicting interests.

The projected speedway is planned to have a width of 100 feet between curbs, with side promenades each 25 feet in width. At two points only in the total distance of about 2½ miles do obstacles exist which cause a change in the established harbor lines to be desirable. These points are situated at High bridge and at Washington bridge.

At High bridge the space between piers is 70 feet, and as the driveway crosses its line at a small angle the carriage space is practically reduced to about 67 feet, while the promenade on the river side is wholly cut off. In the opinion of the Board, an iron footway about 12 feet in width carried around the river side of the outer pier would meet all needs; but if the city authorities are not satisfied with this arrangement of the difficulty the bridge pier obstructing the carriageway may be replaced by an iron truss covering two spans and affording the full width desired. At this locality, therefore, the Board can not recommend any change in the established harbor lines.

---

*Omitted.

At Washington bridge the difficulty is more serious. The abutment unfortunately stands in the middle of the projected carriageway, leaving a minimum space between it and the established bulkhead line of only about 41 feet. The application is to shift the bulkhead line at this place about 58 feet toward the channel. But as the width here has already been reduced from 400 feet to 375 feet, as noted above, this would leave a width of channel of only about 317 feet, which is a reduction greater than the Board thinks advisable, since the east bank is suitable to and will be used for commercial purposes involving the lying of vessels along the bulkhead, thus further reducing the waterway.

The Board regards any encroachment on the channel as injurious and as likely in the future to give rise to well-grounded complaints from the shipping interests.

In view of the need of an ample highway, the Board, however, recommends that an additional width of about 21 feet be given by modifying the established harbor line as explained below and as shown on the accompanying map.* This plan involves an interruption to the promenade on the river side in the vicinity of the abutment, which may be obviated either by an iron foot bridge on the water side leaving a clear headway of 24 feet, or by two iron footbridges crossing to the west promenade at suitable distances before reaching and after leaving Washington bridge. Similar bridges are now used at several street crossings of the New York Central Railroad north of the Forty-second street station.

This plan is regarded as a compromise not wholly satisfactory, and the difficulty can better be met by the purchase by the city of a space on the east bank identical with that called for by the desired extension of the bulkhead line on the west bank and the shifting of the established bulkhead lines on both banks to the eastward, preserving the full width of channel (375 feet) between them, as now determined. This alternative plan the Board prefers, if satisfactory to the city authorities.

The modification of the harbor lines suggested above may be precisely defined as follows:

Beginning at a point A on the harbor line on the west bank of the Harlem River established by the Secretary of War October 18, 1890, 721 feet south of the center line of the western abutment of Washington bridge, the recommended line runs thence northerly in a sraight course a distance of 1,630 feet to a point B in the said harbor line 889 feet north of the center line of said western abutment.

The coordinates of the point A are north 6180.03 and east 741.48, and those of point B are north 7806.61 and east 708.37; the origin of coordinates being the southeast corner of Tenth avenue at its intersection with One hundred and fifty-fifth street, New York City.

The modified line so drawn will pass to the eastward of the eastern face of the western abutment of Washington bridge a distance of 62 feet approximately and eastward of the established harbor line at that point a distance of 21 feet. Such a line gives all the extension of the harbor line at that point which the Board thinks can be granted consistently with a due regard to the "preservation and protection of the navigable waters" of the Harlem River.

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* Omitted.

Respectfully submitted:

HENRY L. ABBOT,
Colonel of Engineers,
Bvt. Brig. Gen., U. S. A.
O. B. COMSTOCK,
Colonel of Engineers,
Bvt. Brig. Gen., U. S. A.
HENRY M. ROBERT,
Lieut. Col. Corps of Engineers.
G. L. GILLESPIE,
Lieut. Col., Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

[First indorsement.]

OFFICE CHIEF OF ENGINEERS,
U. S. ARMY,
September 23, 1893.

Respectfully returned to the Secretary of War, with recommendation that the modification of the established harbor line for the Harlem River at "Washington bridge," as explained in the within report and delineated on the accompanying drawing, be approved, and that the Secretary place his approval both upon this report and upon the drawing.

THOS. LINCOLN CASEY,
Brig. Gen., Chief of Engineers.

[Second indorsement.]

WAR DEPARTMENT, *October 2, 1893.*

The within report of the New York Harbor Line Board is approved as recommended by the Chief of Engineers.

DANIEL S. LAMONT,
Secretary of War.

E 15.

ESTABLISHMENT OF HARBOR LINES ALONG WESTCHESTER CREEK, NEW YORK.

NEW YORK, *June 12, 1894.*

SIR: I respectfully request that a dock or harbor line be established along Westchester Creek, Westchester County, New York. Several bulkhead docks are already built.

Yours,

ALEX. J. HOWELL.

Hon. SECRETARY OF WAR.

REPORT OF LIEUT. COL. G. L. GILLESPIE, CORPS OF ENGINEERS.

ENGINEER OFFICE, U. S. ARMY,
New York, N. Y., June 23, 1894.

GENERAL: Referring to second indorsement, office Chief of Engineers, June 14, 1894, I have the honor to say that, in my opinion, harbor lines should be established along Westchester Creek.

The width of the stream at the entrance to the estuary, estimated between the high-water lines of the two banks, is 550 feet, and at the head of navigation 100 feet.

These widths are already small, and can not be diminished by artificial structures without endangering the future commercial importance of the creek.

At present navigation is carried on chiefly at high water, as the average depth in the channel is 4 to 5 feet only, the range of tides being 7 feet approximately. There are few wharves upon the stream, and none project beyond the low-water line.

It is not practicable to describe by precise courses and distances the harbor lines herein recommended for adoption, as there are no improvements, built of permanent materials, along the banks to which the different points of the lines may be referred by coordinates.

It is therefore deemed preferable to locate them by the high-water and low-water marks represented upon the latest chart of Westchester Creek, prepared from the survey of May-June, 1891, to which reference is made in the Annual Report of the Chief of Engineers, 1891, part 1, p. 955, and to show upon an illustrative map the exact distances between the harbor lines of the two banks at different points from the estuary to the head of navigation at Westchester.

The improvement proposed for this stream in 1891 contemplated a channel width of 100 feet across the estuary; thence 80 feet width to a point 1,000 feet above Scriven's Wharf; and thence 60 feet width to the head of navigation. (Annual Report Chief of Engineers, 1891, part 1, p. 956.)

I have the honor to recommend that the bulkhead line of each bank be located generally along the high-water line, and be given such directions as will avoid undue sinuosities, and that the pierhead line of each bank follow the adjacent low-water line in such manner that the width between the opposite bulkheads shall diminish uniformly from 500 feet at the entrance to 100 feet at Westchester.

The exact relations between the two sets of lines at every point between the estuary entrance and the head of navigation are clearly delineated upon an accompanying tracing,* which is is a copy of the chart prepared from the survey of 1891.

The proposed lines have been exhibited to as many parties in interest along the river as could be reached, and no opposition to their establishment has been expressed.

Very respectfully, your obedient servant,

G. L. GILLESPIE,
Lieut. Col., Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

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* Omitted.

[First indorsement.]

OFFICE CHIEF OF ENGINEERS,
U. S. ARMY,
June 28, 1894.

Respectfully submitted to the Secretary of War.

The establishment of harbor lines along Westchester Creek having been requested, the subject has been given careful consideration by Lieut. Col. G. L. Gillespie, Corps of Engineers, to whose report herein attention is respectfully invited.

Col. Gillespie is of the opinion that harbor lines should be established along Westchester Creek from the estuary at East River to Westchester, N. Y., and he accordingly submits the accompanying drawing* on which are delineated the pier-head and bulkhead lines, the establishment of which is considered essential.

I recommend that these lines be approved, and that the Secretary place his approval both upon this report and upon the drawing.

THOS. LINCOLN CASEY,
Brig. Gen., Chief of Engineers.

[Second indorsement.]

WAR DEPARTMENT, *June 29, 1894.*

Approved as recommended by the Chief of Engineers.

DANIEL S. LAMONT,
Secretary of War.

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* Omitted.

APPENDIX F.

IMPROVEMENT OF RIVERS AND HARBORS IN SOUTHWESTERN PART OF LONG ISLAND AND NEAR STATEN ISLAND, NEW YORK, AND IN NORTHEASTERN NEW JERSEY.

REPORT OF CAPT. THOMAS L. CASEY, CORPS OF ENGINEERS, OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1894, WITH OTHER DOCUMENTS RELATING TO THE WORKS.

IMPROVEMENTS.

1. Sumpawanus Inlet, New York.
2. Canarsie Bay, New York.
3. Sheepshead Bay, New York.
4. Arthur Kill, New York and New Jersey.
5. Channel between Staten Island and New Jersey.
6. Passaic River, New Jersey.
7. Elizabeth River, New Jersey.
8. Rahway River, New Jersey.
9. Raritan River, New Jersey.
10. South River, New Jersey.
11. Keyport Harbor, New Jersey.
12. Mattawan Creek, New Jersey.
13. Shoal Harbor and Compton Creek, New Jersey.
14. Shrewsbury River, New Jersey.
15. Manasquan (Squan) River, New Jersey.
16. Removing sunken vessels or craft obstructing or endangering navigation.

HARBOR LINES.

17. Shrewsbury River, New Jersey.

ENGINEER OFFICE, U. S. ARMY,
New York, July 9, 1894.

GENERAL: I have the honor to transmit herewith my annual report on the works of river and harbor improvement in my charge for the fiscal year ending June 30, 1894.

Very respectfully, your obedient servant,

THOS. L. CASEY,
Captain, Corps of Engineers.

Brig. Gen. THOMAS. L. CASEY,
Chief of Engineers, U. S. A.

F 1.

IMPROVEMENT OF SUMPAWANUS INLET, NEW YORK.

Sumpawanus Inlet, known in the neighborhood and on the Coast Survey charts as Sumpawams Creek, is a small creek on the south side of Long Island, emptying into the Great South Bay. It lies about 36 miles east of New York City, 15 miles east of the western end of Great South Bay, and nearly twice as far from its eastern end.

The project of improvement provides for dredging a channel 150 feet wide and 5 feet deep at mean low water from the 5-foot curve in the bay to the steamboat dock at the mouth of the creek, a distance of about 1,500 feet, and thence 5 feet deep and 100 feet wide up the inlet to the town of Babylon, a distance of about 3,500 feet farther. The estimated cost of making this improvement is $23,115.

Of this amount $7,000 has been appropriated, the last allotment being included in the act of August 2, 1882. With this sum the channel was given a width of 75 feet, and mean low water depth of 5 feet from the steamboat wharf to a point 750 feet below, besides two cuts, each 25 feet wide, alongside the wharf. The improvement has, however, not been permanent, as shown by an examination made in 1886.

Ten thousand dollars can be expended in giving a 5-foot channel out into the bay for the use of steamboats, but I think that the work is more a matter of local than public interest.

This work is in the collection district of New York, which is the nearest port of entry. Nearest light-house, Fire Island Light; nearest fort, Fort Hamilton.

The amount of revenue collected at the port of New York during the fiscal year ending June 30, 1894, was $87,849,487.58.

AMOUNTS APPROPRIATED.

By act of—	
March 3, 1881	$5,000
August 2, 1882	2,000
Total	7,000
Amount expended	7,000

Money statement.

Amount (estimated) required for completion of existing project	$16,115 00
Amount that can be profitably expended in fiscal year ending June 30, 1896	10,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

COMMERCIAL STATISTICS.

The following statistics relative to the commerce of Sumpawanus Inlet, New York, during the year ending December 31, 1893, were kindly furnished by Hon. James B. Cooper, justice of the peace, Babylon, L. I.

Articles.	Amount.	Value.	Vessels.	Number.	Average draft.	Average tonnage.
	Tons.				*Feet.*	*Tons.*
Oysters and clams	140	$28,000	Steam	2	4½	80
Fish	330	46 200	Sail	310	2¼	12
Building material	800	22,000				
Miscellaneous	80	7,500				
Total	1,350	103,700		312		

This table shows a decrease of 70 tons when compared with that given for calendar year 1892.

F 2.

IMPROVEMENT OF CANARSIE BAY, NEW YORK.

The first survey of this bay with a view to its improvement was made in 1879. The scheme of improvement involved a channel 6 feet deep at mean low water, and 100 to 150 feet wide, extending from the shore at Canarsie Landing to the navigable channel in Jamaica Bay, a distance of about 3,500 feet. It was thought that the channel might be maintained by the construction of two pile dikes, forming a tidal reservoir. The estimated cost under this project was $88,000. A history of the work in considerable detail is given in the Annual Report of the Chief of Engineers for 1887, Part I, p. 637.

The total amount expended on this improvement to June 30, 1893, was $48,535.88, with which two pile dikes had been built and maintained on the north and south sides of the channel at its entrance into Jamaica Bay 1,058 and 820 feet long, respectively, and the channel dredged to a depth of 6 feet at mean low water and width of about 125 feet from Canarsie Landing to the deep water of the bay. In addition to this several other improvements not contemplated in the main project, but which added materially to the facility of navigation or to the maintenance of the channel, had been executed, viz, the excavation of a cut 100 feet long and 50 feet wide, with a depth of 6 feet, on the east side of the steamboat landing at Canarsie, and a cut at the end of the wharf at Canarsie Landing extending through to the southwest to connect with the southwest channel, the latter for the purpose of promoting tidal circulation. The tidal currents are due to a mean rise and fall of 4.7 feet.

Dredging under contract dated April 15, 1893, with J. H. Fenner, of Jersey City, N. J., as detailed in my Annual Report for 1893, p. 1101, was begun May 23, 1893, and at the close of that fiscal year 7,867 cubic yards of material had been removed. This contract was concluded July 12, 1893, with a total removal of 10,800 cubic yards of material, 2,805 cubic yards of which was dredged from the main channel, and 7,995 cubic yards from the west channel, at 24 cents and 40 cents per cubic yard, respectively.

Under this contract the main channel alongside and in front of Canarsie Landing attained a mean low-water depth of 6 feet and width of 70 feet for a distance of 440 feet, and the west channel was given a mean low-water depth of 4 feet, with widths of from 20 to 70 feet, for a distance of 1,317 feet. Slight necessary repairs were made to the east dike in December, 1893.

The expenditures during the fiscal year amounted to $4,462.02, as follows:

Dredging under contract	$3,871.20
Repairing dike	143.23
Inspection	40.00
Drafting	150.00
Administration	257.59
Total	4,462.02

Canarsie Landing besides being the terminus of the Brooklyn, Rockaway Beach and Jamaica Bay Railroad, from which passengers are transshipped by steamer to Rockaway Beach, has a large fishing industry.

It is thought that $10,000 will suffice to complete the present scheme of improvement, but other amounts will have to be appropriated from time to time in order to maintain the channels.

This work is in the collection district of New York, which is the nearest port of entry. Nearest light-house, Fort Tompkins Light; nearest fort, Fort Hamilton.

The amount of revenue collected at the port of New York during the fiscal year ending June 30, 1894, was $87,849,487.58.

AMOUNTS APPROPRIATED.

By act of—

June 14, 1880	$10,000.00
March 3, 1881	5,000.00
August 2, 1882	3,000.00
July 5, 1884	5,000,00
August 5, 1886	10,000.00
August 11, 1888	10,000.00
September 19, 1890	5,000.00
July 13, 1892	5,000.00
Total	53,000.00
Amount expended	52,997.90

Money statement.

July 1, 1893, balance unexpended	$4,464.12
June 30, 1894, amount expended during fiscal year	4,462.02
July 1, 1894, balance unexpended	2.10
Amount (estimated) required for completion of existing project	35,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	8,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

COMMERCIAL STATISTICS.

The following statistics relative to the commerce of Canarsie Bay, New York, during the year ending December 31, 1893, were furnished by Mr. William Warner, superintendent of the Brooklyn, Jamaica Bay and Rockaway Beach Railroad:

Articles.	Amount.	Value.	Vessels.	Number.	Average draft.	Average tonnage.
	Tons.				*Feet.*	*Tons.*
Fish	3,010	$215,000	Steam	6	5½	300
Coal	5,500	16,000	Sail	75	5¼	16
Fertilizers	43,000	43,000	Yachts	100	3¼	4
Oysters and clams	18.000	36,500				
Total	69,510	310,500		181		

The above table shows an increase of 2,000 tons over that reported for year 1892.

F 3.

IMPROVEMENT OF SHEEPSHEAD BAY, NEW YORK.

Sheepshead Bay, Long Island, is a small tidal bay about 2 miles long, lying inside Coney Island, New York, and extending easterly from the village of Gravesend to Rockaway Inlet, into which it empties. Its width varies from 100 to 1,000 feet, and its depths from 0 to 10 feet at mean low water. The natural entrance is subject to progressive changes of position, due to the action of the waves on the sandy beaches.

The original project for the formation and maintenance of a dredged channel 100 feet wide and 6 feet deep, mean low water, was modified in February, 1889, the modified project contemplating a channel 5,350 feet long, 60 feet wide, and 5½ feet deep, mean low water, from the town of Sheepshead to within 1,080 feet of Dead Horse Inlet Cut, to connect with the channel of similar width and depth already existing at that point. This channel, which was completed December 6, 1889, seems to have maintained itself in a very satisfactory manner.

The amount expended on this project to the end of the fiscal year ending June 30, 1893, was $25,943.45.

With this amount a channel had been dredged 100 feet wide and 6 feet deep at mean low water, connecting the east end of the bay with Dead Horse Inlet, and the interior channel dredged 60 feet wide and 5½ feet deep, at mean low water, for a distance of 3,400 feet from the town of Sheepshead toward Dead Horse Inlet. The first-mentioned channel, from a survey in 1887, was observed to have not maintained itself, having contracted to a width of 60 feet with an average depth of 5½ feet mean low water.

Sheepshead Bay is a harbor of minor importance, and must so continue until the entrance can be improved by an expensive system of jetties. At present it is for the most part used as a haven for small oyster and clam boats and for a large fleet of pleasure boats in the summer season. The utility of future appropriations must be judged of, therefore, by these facts.

The expenditures for the fiscal year ending June 30, 1894, amount to $24.50 for office expenses.

This work is in the collection district of New York, which is the nearest port of entry; nearest light-house, Fort Tompkins Light; nearest fort, Fort Hamilton.

The amount of revenue collected at the port of New York during the fiscal year ending June 30, 1894, is $87,849,487.58.

Original estimate (1879)	$100,000
Revised estimate (1882)	34,200

AMOUNTS APPROPRIATED.

By act of—	
June 14, 1880	$3,000.00
March 3, 1881	5,000.00
August 2, 1882	3,000.00
July 5, 1884	5,000.00
August 5, 1886	5,000.00
August 11, 1888	5,000.00
Total	26,000.00
Amount expended	25,967.95

Money statement.

July 1, 1893, balance unexpended	$56.55
June 30, 1894, amount expended during fiscal year	24.50
July 1, 1894, balance unexpended	32.05
July 1, 1894, outstanding liabilities	29.68
July 1, 1894, balance available	2.37
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	8,200.00

F 4.

IMPROVEMENT OF ARTHUR KILL, NEW YORK AND NEW JERSEY.

A history of this improvement, which originated by special resolution of the Committee of Commerce in the Senate, is given in the Annual Report of the Chief of Engineers for 1889, Part I, p. 819, and a further statement of the condemnation proceedings necessary for the acquirement of the land forming Steep Point is given in my Annual Report for 1890, p. 843. The approved project provides for the removal of this point of land by successive parallel cuts to the regular channel depth, with the object of rectifying the current near the Baltimore and Ohio Railroad bridge. It is estimated to cost $26,500.

Up to June 30, 1893, $21,090.74 had been expended in acquiring the land and in dredging off about 1⅓ acres of the point, increasing the width of the channel by 225 feet, and resulting, as observation shows, in directing the currents more nearly perpendicular to the bridge. The total width of the channel at this point is now 725 feet, with a minimum depth of 13 feet at mean low water.

The balance of funds pertaining to this improvement were insufficient to permit the continuance of active operations during the present fiscal year and no work has therefore been attempted. The expenditures during the fiscal year amount to $380 for office expenses.

The balance of the estimate ($4,500) can be profitably expended in completing the work.

This work is in the collection district of New York, which is the nearest port of entry; nearest light-house, Bergen Point Light; nearest fort, Fort Tompkins.

Amount of revenue collected at the port of New York during the fiscal year ending June 30, 1894, is $87,849,487.58.

AMOUNTS APPROPRIATED.

By act of—	
August 11, 1888	$10,000.00
September 19, 1890	7,000.00
July 13, 1892	5,000.00
Total	22,000.00
Amount expended	21,470.74

Money statement.

July 1, 1893, balance unexpended	$909.26
June 30, 1894, amount expended during fiscal year	380.00
July 1, 1894, balance unexpended	529.26
Amount available for fiscal year ending June 30, 1895	529.26
Amount (estimated) required for completion of existing project	4,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	4,500.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

COMMERCIAL STATISTICS.

The following statistics relative to the commerce of Arthur Kill, New York and New Jersey, during the year ending December 31, 1893, were compiled from statements furnished by parties making shipments over this waterway.

Articles.	Amount.	Value.	Vessels.	Number.	Average draft.	Average tonnage.
	Tons.				*Feet.*	*Tons.*
Coal	2,522,210	$9,504,652	Steam	200	12	556
Oils	64,000	1,210,000	Sail	1,002	14	395
Iron and ores	32,752	1,072,700	Barges	2,977	11	690
Building material	117,815	844,583	Rafts	6,873		
Miscellaneous	641,531	18,908,200				
Total	3,384,308	31,630,135		11,052		

The above table shows a decrease of 1,450,696 tons when compared with amount reported for year 1892. This decrease is, to a great extent, due to the failure of shippers to reply to letters requesting this information.

F 5.

IMPROVEMENT OF CHANNEL BETWEEN STATEN ISLAND AND NEW JERSEY.

A description of this channel and a complete history of the work done toward its improvement may be found in the Annual Report of the Chief of Engineers for 1887, Part I, p. 743.

Thus far the improvement has been confined to that portion of the channel (about 1¾ miles long) which lies to the east of Elizabethport, N. J., and at the mouth of Newark Bay. This originally had a depth of only 9½ feet at mean low water, while the remainder, lying between the shores of Staten Island and New Jersey, had a depth of from 14 to 40 feet at mean low water.

The present project, adopted October 20, 1890, contemplates dredging the channel to a uniform depth of 14 feet at mean low water over the entire width of 400 feet.

The amount expended on this improvement to June 30, 1893, was $198,243.88, and the total amount of work accomplished consisted in the construction of a short dike and the dredging of a channel throughout the entire extent of the improvement, 13 feet in depth at mean low water, with widths varying from 300 to 350 feet. It should be added, also, that for 3,000 feet in the vicinity of the bend at the Stake Light the width had been increased to 400 feet, with low-water depths of from 13 to 14 feet.

An appropriation of $15,000 was made in the act of July 13, 1892. A project for the expenditure of this appropriation in widening and deepening the channel at such points as prove on examination to be most deficient, the work to be done by contract after advertisement and award, in accordance with regulations, was approved July 26, 1892.

Work under the project was deferred pending a survey of the channel in the vicinity of the Corner Stake Light to determine the amount of shoaling that had taken place at this locality since dredging was last done. This survey was made in November, 1893, and showed that the improved channel with widths of from 300 to 350 feet and depth of 13 feet mean low water, between Shooters Island and the Corner Stake Light, had contracted in places to a width of about 200 feet; and that in the vicinity of the bend at the Stake Light, where a 400-foot width had been given the channel, with mean low-water depths of from 13 to 14 feet, the width corresponding to the aforementioned depths was only about 140 feet.

A communication to the Chief of Engineers, dated March 17, 1894, recommending that the work of improvement under the above-mentioned project be performed by the United States Dredging Plant while temporarily thrown out of service on the Raritan River, by reason of the new method of breaking up the rock by percussion which was in progress there, instead of by contract, as the method most economical and advantageous to the Government, was approved March 20, 1894, and work will be begun early in July, when it is expected the plant will have completed the season's work on the Raritan River.

The expenditures during the fiscal year amount to $1,727, as follows:

Survey	$257.50
Drafting	150.00
Repairs to dredging plant	779.50
Administration	540.00
Total	1,727.00

This work is in the collection district of New York, which is the nearest port of entry. Nearest light-house, Bergen Point Light; nearest fort, Fort Tompkins.

Amount of revenue collected at the port of New York during the fiscal year ending June 30, 1894, $87,849,487.58.

AMOUNTS APPROPRIATED.

By act of—		By act of—	
June 23, 1874 (diking)	$50,000.00	August 11, 1888	$15,000.00
August 14, 1876 (dredging)	10,000.00	September 19, 1890	15,000.00
June 18, 1878	15,000.00	July 13, 1892	15,000.00
June 14, 1880	29,000.00		
August 2, 1882	40,000.00	Total	214,000.00
July 5, 1884	10,000.00	Amount expended	199,970.88
August 5, 1886	15,000.00		

Money statement.

July 1, 1893, balance unexpended	$15,756.12
June 30, 1894, amount expended during fiscal year	1,727.00
July 1, 1894, balance unexpended	14,029.12
July 1, 1894, outstanding liabilities	128.50
July 1, 1894, balance available	13,900.62
Amount (estimated) required for completion of existing project	46,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	30,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

COMMERCIAL STATISTICS.

The following statistics relative to the commerce of channel between Staten Island and New Jersey, during the year ending December 31, 1893, were compiled from statements furnished by parties making shipments over this waterway:

Articles.	Amount.	Value.	Vessels.	Number.	Average draft.	Average tonnage.
	Tons.				*Feet.*	*Tons.*
Coal	2,383,549	$8,969,325	Steam	163	11	418
Building material	54,998	573,180	Sail	603	13	396
Fertilizers	65,393	751,764	Barges	3,914	12	412
Iron and ores	165,950	3,982,800	Rafts	1,401		
Miscellaneous	814,021	40,276,210				
Total	3,483,911	54,553,279		6,081		

The above table shows a decrease of 160,003 tons when compared with that reported for year 1892.

F 6.

IMPROVEMENT OF PASSAIC RIVER, NEW JERSEY.

The Passaic River is being improved under two separate projects, the first applying to the river below Center street bridge, Newark, to and beyond the shoal in Newark Bay, a distance of 7⅝ miles; the second to the upper course of the river from Center street bridge as far as Passaic, a distance of 8 miles. The most recent appropriation was, however, made in a single sum for the entire river, and hereafter the two projects will be united in such a way that the funds can be expended at those parts of the river most urgently needing control or repair in the interests of navigation.

1. BELOW NEWARK.

The lower portion of the river from Center street bridge to Newark Bay was first surveyed by the Engineer Department in 1879. The greatest depth in the channel at a point above the Elbow Beacon was only 7.1 feet, and in many places the greatest depth was 7.5 feet at mean low water. A project was adopted, based on this survey, providing for obtaining, by diking and dredging, a channel 200 feet wide and 10 feet deep at mean low water, from Center street bridge to Newark Bay, at a cost of $232,875.

This project was modified in 1884, pursuant to the river and harbor act of that year, providing for extending the dike at the mouth of the river into the bay, a distance of 12,000 feet, and for dredging a channel across the shoal in Newark Bay 200 feet wide and 10 feet deep at mean low water, increasing the original estimate to $353,875.

The amount expended to June 30, 1893, was $236,283.24, with which 6,205 feet of dike had been built and maintained, the channel through the shoal in the bay and the channel up the river as far as Lister Dock dredged to the required dimensions, and a bar above the Zinc Works Dock removed to the required depth, with a width of 120 feet for a distance of 1,600 feet upstream.

The river and harbor act of July 13, 1892, appropriated $45,000 for the entire river both above and below Newark. A project for its expenditure was approved July 26, 1892, the portion of the project referring to this section of the river reading as follows:

> For dredging between Center street bridge, Newark, and deep water in Newark Bay at points where the channel is deficient in width and depth, as provided for in the original project, $20,250.
>
> Reserved for the preservation of the dike in Newark Bay endangered by the reclaiming of isolated sections of land inside the approved bulkhead lines, or to be expended in dredging hereafter, as may seem most advantageous, and for which due authority will be obtained, $10,000.

Work under contract dated April 28, 1893, with P. Sanford Ross, of Jersey City, N. J., for dredging this section of the river (detailed in Annual Report, 1893, p. 1109) was begun June 14, 1893, and at the close of that fiscal year 11,294 cubic yards of material had been removed. This work was continued to September 30, 1893, at which date the contract closed after a total removal of 70,340 cubic yards, 59,046 of which were removed during the present fiscal year.

In this work two machines were almost constantly occupied in dredging the material, 30,685 cubic yards of which was disposed of at sea in conformity with act of Congress approved June 29, 1888, and the remainder deposited along the face of the dike in Newark Bay for a distance of about 4,000 feet between the bridges of the Jersey Central and

Lehigh Valley railroads, where a third machine was engaged in casting it over the dike, completing the spoil bank already formed at this section with material dredged in 1890 and 1891 (166,700 cubic yards) to an elevation of from 7 to 10 feet above the dike, the crest being from 40 to 60 feet back of dike, with a width of from 100 to 250 feet at the base.

Under this contract the channel between Center street and Market street bridges, Newark, was dredged to the required mean low-water depth of 10 feet and width of 210 feet for a distance of 1,800 feet downstream, thence from a point in the channel 1,000 feet below the Market street bridge to the Newark Steel Works, a distance of 5,000 feet, the channel was increased in width 25 to 100 feet bringing it to the full dimensions required by the project, viz, 200 feet wide and 10 feet deep mean low water. In addition to the above a cut of the requisite depth, having a width of 30 feet, was made along the south side of the channel opposite Lister Dock for a distance of about 1,000 feet, increasing the channel width at this point to 175 to 200 feet.

To guard against the material in the spoil bank being washed back into the river through the dike, which was of open construction, the inner side for a distance of about 3,500 feet was sheet-piled with 2-inch yellow pine, 8 to 12 inches wide and 8 feet long, projecting 1 foot above its top. Slight necessary repairs were made to the timber work of the dike, and the stone filling renewed where needed; this cost $4,307.00. Additional protective measures for the maintenance of the embankment and dike, viz, the paving of the face of the embankment with shale rock dredged from the Raritan River, estimated to cost $2,500, and for which the approval of the Chief of Engineers was obtained May 16, 1894, have been begun and are in progress at the close of the fiscal year.

The expenditures on this section of the river during the fiscal year amount to $30,299.71, as follows:

Dredging under contract	$23,212.20
Repairs to embankment and dike	4,449.44
Surveying	301.40
Drafting	300.00
Inspection	1,103.34
Administration	933.33
Total	30,299.71

2. ABOVE NEWARK.

Before its improvement was undertaken the upper part of the river had a navigable 6-foot channel, except at Middle, Belleville, Rutherford Park, and Holzman bars, where the depths were 4.5 feet, 3.9 feet, 3 feet, and 3.5 feet, respectively.

The project of improvement was adopted in 1872, and provided for a channel across and above the shoals from 7½ to 6 feet deep at mean low water, and from 200 to 50 feet wide, to be obtained by dredging and diking, at a cost of $123,924. It was modified in 1885 by extending the channel below Middle Bar 1,500 feet to the Erie railroad bridge, increasing the estimate to $129,000, which was further increased in 1886 to $133,762. The deposit of material from freshets, as well as the difficult and costly nature of the dredging, prompted a recommendation to increase this last estimate to $193,822, which was approved October 6, 1890.

The amount expended to June 30, 1893, was $138,484.97, with which channels had been dredged to the requisite depth, with width of from 60 to 75 feet, a channel through Third River Bar dredged to the required depth, with width of 100 feet for a distance of 800 feet, and below this bar the channel was increased in width by 40 feet with the same depth for a distance of 700 feet, and by 20 feet for a further distance of 245 feet, giving a continuous 100-foot channel through this reach, having a uniform depth of 6 feet at mean low water., In addition a channel through Belleville Bar was completed to a width of 100 feet and mean low-water depth of from 6 to 7 feet.

The river and harbor act of July 13, 1892, appropriated $45,000 for the entire river, both above and below Newark. A project for its expenditure was approved July 26, 1892, that part of the project alluding to this section of the river reading as follows: "For dredging at Belleville Bar, completing the project, and at Rutherford Park Bar, widening the channel, $8,000."

Work under contract dated September 24, 1892, with James McSpirit, of Jersey City, N. J., in progress at the close of the last fiscal year, details of which will be found in Annual Report, 1893, p. 1110, was continued to September 1, 1893, at which date the contract was closed with a total removal of 9,715 cubic yards of material, consisting of sand, clay, gravel, and large bowlders, 4,515 cubic yards of this amount having been removed during the present fiscal year.

Under this contract the channel through Belleville Bar was given a mean low-water depth of from 6 to 7 feet and width of 100 feet; the channel through Holzman Bar widened 35 feet, with a mean low-water depth of from 6 to 8 feet, for a distance of 418 feet, and the channel through Rutherford Park Bar given a similar depth, with a width of 85 to 100 feet, for a distance of 1,035 feet.

The expenditures during the fiscal year ending June 30, 1894, amount to $6,846.25, as follows:

Dredging, under contract	$6,272.92
Inspection	233.33
Administration	340.00
Total	6,846.25

Passaic River is in the collection district of Newark, which is the nearest port of entry. Nearest light-house, Passaic Light, at the lower end of dike in Newark Bay. Fort Tompkins is the nearest fort.

Amount of revenue collected at the port of Newark during the fiscal year ending June 30, 1894, $35,873.49.

AMOUNTS APPROPRIATED.

By act of Congress approved—	Below Newark.	Above Newark.	Total.
June 10, 1872		$25,000.00	$25,000.00
March 3, 1873		25,000.00	23,000.00
June 23, 1874		20,000.00	20,000.00
March 3, 1875		20,000.00	20,000.00
August 10, 1876		10,000.00	10,000.00
June 18, 1878		10,000.00	10,000.00
March 3, 1879		2,000.00	2,000.00
June 14, 1880	$30,000.00	2,000.00	32,000.00
March 3, 1881	50,000.00		50,000.00
August 2, 1882	43,000.00	7,000.00	50,000.00
July 5, 1884	25,000.00	3,000.00	28,000.00
August 5, 1886	24,000.00	2,250.00	26,250.00
August 11, 1888	27,500.00	7,500.00	35,000.00
September 9, 1890	40,000.00	5,100.00	45,100.00
July 13, 1892	For entire river.		45,000.00
Total	239,500.00	138,850.00	423,350.00
Amount expended	266,582.95	145,331.22	411,914.17

As the river and harbor act approved July 13, 1892, makes the appropriation for the two reaches of the river under one heading, the following consolidated money statement for Passaic River is presented:

Money statement.

July 1, 1893, balance unexpended		$48,581.79
June 30, 1894, amount expended during fiscal year:		
Below Newark	$30,299.71	
Above Newark	6,846.25	
		37,145.96
July 1, 1894, balance unexpended		11,435.83
July 1, 1894, outstanding liabilities		1,356.31
July 1, 1894, balance available		10,079.52
Amount (estimated) required for completion of existing project		124,317.00
Amount that can be profitably expended in fiscal year ending June 30, 1896		60,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

COMMERCIAL STATISTICS.

The following statistics relative to the commerce of Passaic River, New Jersey, during the year ending December 31, 1893, were furnished by Mr. P. T. Quinn, secretary of the Board of Trade, Newark, N. J.:

Articles.	Amount.	Value.	Vessels.	Number.	Average draft.	Average tonnage.
	Tons.				*Feet.*	*Tons.*
Building material	315,709	$4,090,230	Steam	8,729	9	475
Iron and ores	221,841	11,092 070	Sail	5,907	8	200
Fertilizers	342,732	3,473,000	Barges	4,974	6	200
Coal	63,750	255,000	Rafts	1,213		
Miscellaneous	332,137	19,619,408				
Total	1,276,169	38,529,708		20,823		

The above table shows a decrease of 86,478 tons when compared with that reported for 1892.

F 7.

IMPROVEMENT OF ELIZABETH RIVER, NEW JERSEY.

This stream, which is 2⅝ miles in length from its mouth to the head of navigation, at Broad street, Elizabeth, has a width of from 50 to 90 feet, and before its improvement the wharves in the city could only be reached at high water by vessels drawing less than 4 feet. Its commerce was estimated at 45,000 tons annually. The range of the tide was about 4.7 feet at its mouth and 3.4 feet at Bridge street.

The project for the improvement was adopted in 1878, and provides for obtaining, by dredging, a channel 60 feet wide and 7 feet deep at high water, from the mouth of the river to the head of navigation, at an estimated cost of $25,530. The estimated cost, under the project of 1878, was increased in 1882 to $43,160.

The total amount expended on this improvement to June 30, 1893, was $32,353.46.

A channel of the required dimensions was dredged in 1883 to within 1,000 feet of the Broad street bridge, but soon became obliterated by reason of deposits of silt and sewage refuse.

There were no funds available for work on this improvement from 1883 until September 19, 1890, when the sum of $5,000 was appropriated in the river and harbor act of that date, and was expended in 1891 in removing shoals from the river at the bend above South street, at South street bridge, at John street, at the bend in the river below John street, and at the New York and Long Branch Railroad bridge, to the required high-water depth, with widths of from 30 to 50 feet; thus providing a channel having a depth of 7 feet at mean high water from the mouth of the river to within 900 feet of the Bridge street bridge, in the town of Elizabeth. The widths of this channel were from 30 to 50 feet.

The act of July 13, 1892, also appropriated $5,000 for continuing the improvement, and a project for its expenditure was approved July 26 1892. A survey at this time indicated a channel from 30 to 50 feet wide, extending from the mouth to Bridge street bridge, the head of navigation, with mean high-water depths as follows: From mouth of the river to about 2,400 feet above the New York and Long Branch Railroad bridge, 7 to 11 feet; thence to within 900 feet of the South street bridge, 6 to 7.3 feet; thence to bend above South street bridge, 5.3 to 6.9 feet; and from this point to the head of navigation, at Bridge street bridge, about 2⅝ miles from the mouth, 4.1 to 5.8 feet.

Bids were invited by public advertisement, dated February 18, 1893, for doing the work in accordance with the above-mentioned project, and none were received at date of opening, March 29, 1893. It was subsequently recommended that this work be left in abeyance until such time as an advantageous offer for doing it could be obtained.

There was no work done on this improvement during the fiscal year ending June 30, 1893.

The approval of the Chief of Engineers was obtained March 20, 1894, for the expenditure of the available appropriation for this improvement in dredging the channel by hired labor in open market, in pursuance with which circular letters inviting proposals were issued, March 22, to the principal dredging contractors in New York, Jersey City, and Albany, with results as follows: William H. Taylor, Jersey City, 76¼ cents; James McSpirit, Jersey City, 95 cents; J. P. Randerson, Albany, $1.10: and Edgar M. Payn, Albany, $1.24 per cubic yard.

The lowest bid received was that of William H. Taylor, 76¼ cents per cubic yard, which, being considered reasonable, was recommended for acceptance April 6, and was approved April 9. Work was begun April 23, at a point in the river between Bridge street and South street bridges, in the town of Elizabeth, 75 feet below the termination of the work under the previous contract, and was completed June 30, 1894, when a total of 5,200 cubic yards, in place, had been removed from the channel and deposited upon the lowland on the west side of the river.

The improved channel was extended a distance of 900 feet to within 125 feet of the Bridge street bridge, which is practically the head of navigation. The channel was given a width of 45 feet and a depth of 7 feet at mean high water where attainable.

Early in the work a fixed red shale was uncovered, cropping out on either side from a few inches to 1 foot above the required depth.

Through the center of the stream, where the eroding action has been greatest, the required depth could uniformly be obtained.

In some places the shale was partially broken down and removed by the dredge bucket, although this was not required by the agreement. The remaining rock here and there along the side next to the wharves is an element of danger to loaded vessels lying aground at low water, and should be removed when the funds available will warrant. There is farther work needed along the river below, in redredging shoals formed by the deposit of sedimentary matter, with which the stream is highly charged.

The expenditures during the fiscal year amount to $2,148.01, as follows:

Dredging by hired plant	$1,530.34
Inspection	266.67
Drafting	150.00
Administration	200.00
Total	2,148.01

The amount that could be profitably expended on this improvement during the fiscal year ending June 30, 1896, is the balance of the estimate—$6,160—and would be applied to the completion of the project.

Elizabeth River is in the collection district of Newark, N. J. Nearest light-house, Bergen Point Light. Nearest fort, Fort Tompkins.

Amount of revenue collected at the port of Newark during the fiscal year ending June 30, 1894, is $35,873.49.

AMOUNTS APPROPRIATED.

By act of—	
March 3, 1879	$7,500.00
June 14, 1880	7,500.00
March 3, 1881	4,000.00
August 2, 1882	8,000.00
September 19, 1890	5,000.00
July 13, 1892	5,000.00
Total	37,000.00
Amount expended	34,501.47

Money statement.

July 1, 1893, balance unexpended	$4,646.54
June 30, 1894, amount expended during fiscal year	2,148.01
July 1, 1894, balance unexpended	2,498.53
July 1, 1894, outstanding liabilities	2,434.66
July 1, 1894, balance available	63.87
Amount (estimated) required for completion of existing project	6,160.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	6,160.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

COMMERCIAL STATISTICS.

The following statistics relative to the commerce of Elizabeth River, New Jersey during the year ending December 31, 1893, were furnished by Mr. Thomas H. Benton, of Elizabeth, N. J.

Articles.	Amount.	Value.	Vessels.	Number.	Average draft.	Average tonnage.
	Tons.				*Feet.*	*Tons.*
Building material	12,854	$67,106	Steam	5	5	20
Coal	14,500	77,250	Sail	114	6	68
Miscellaneous	1,200	6,000	Barges	185	5½	150
			Rafts	2		
Total	28,554	150,356		306		

The above table shows a decrease of 11,021 tons when compared with that reported for year 1892.

F 8.

IMPROVEMENT OF RAHWAY RIVER, NEW JERSEY.

In its original condition the Rahway River had a depth of 8 feet and more at mean high water from its mouth to Bricktown, 3⅝ miles; 7 feet at Edgar Dock, 4½ miles; 4.4 feet to Milton avenue bridge, 4¾ miles; and 4 feet to Main street bridge, 5 miles, in the town of Rahway. Its commerce was estimated at 120,000 tons, and three attempts had been made to establish a line of steamboats on the river, but had failed on account of the bad condition of the stream.

The original project for its improvement was adopted in 1878, and provided for dredging a channel 125 feet wide and 8 feet deep at high water from Bricktown to Milton avenue bridge and 100 feet wide from that point to Main street bridge. The tide rises about 5 feet at the mouth and 4 feet at the head of navigation.

The amount expended on this improvement to June 30, 1893, was $37,000 with which the channel had been given a depth of 7 feet at mean high water and width of from 100 to 50 feet to within 550 feet of the head of navigation. Freshet material and sewage refuse have. however, obliterated all trace of this dredging, and under present conditions it will be impossible to permanently deepen the channel.

There has been no appropriation for this work since 1882.

If it is the intention of Congress to complete the improvement, the balance of the estimate ($29,250) could be profitably used in redredging the channels in accordance with the original project.

This work is in the collection district of Perth Amboy, N. J., which is the nearest port of entry. The nearest light-house is Princess Bay Light, and Fort Tompkins is the nearest fort.

Amount of revenue collected at the port of Perth Amboy, N. J., during the fiscal year ending June 30, 1894, is $ ——.

AMOUNTS APPROPRIATED.

By act of—	
March 3, 1879	$10,000
June 14, 1880	10,000
March 3, 1881	10,000
August 2, 1882	7,000
Total	37,000
Amount expended	37,000

Money statement.

Amount (estimated) required for completion of existing project	$29,250.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	29,250.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

COMMERCIAL STATISTICS.

The following letter contains all of the obtainable information in regard to the commerce of Rahway River, New Jersey, during the year ending December 31, 1893:

RAHWAY, *February 13, 1894.*

DEAR SIR: In reply to your communication of February 6, asking for commercial statistics in relation to Rahway River, I would say that we had nearly five millions of bricks landed here during the year ending December 31, 1893, by light-draft sailing vessels, with other building materials in correspondingly increased quantities over the preceding year. There has been no apparent increase in coal tonnage over last year's report, but large quantities of potters' products have been shipped from Leonard's Pottery and Terra Cotta Works by water, which, prior to last year, went either by rail or team. There has also been a decided increase in the traffic of oysters, fish, and clams by small sailing craft to this point for marketing during the past season. The building of extensive soap works on the river opposite the Cloke homestead is contemplated in the near future, which, when done, will add materially to our commerce.

Yours, very truly,

JOSEPH M. POTTER.

THOS. L. CASEY,
Captain, Corps of Engineers.

F 9.

IMPROVEMENT OF RARITAN RIVER, NEW JERSEY.

Before its improvement by the United States the Raritan River had a depth of 8.5 feet at "The Stakes," 3 miles; of 6.5 feet at the "Middle Grounds," 4½ miles; of 7.5 feet at Whitehead Sand Dock, 8½ miles; and between this point and New Brunswick, 12¼ miles above the mouth, the channel was obstructed by a number of rocky shoals, with depths of from 8.4 feet to 6.9 feet at mean low water. The city of New Brunswick and the Delaware and Raritan Canal, which terminates here, together with extensive brick yards on the South River, had an extensive commerce on the stream, estimated in 1871 at 3,053,857 tons per annum.

The present project was adopted in 1874, and provides for obtaining by diking and dredging, and where necessary, by drilling and blasting rock, a channel 200 feet wide and 10 feet deep at mean low water, from the mouth to New Brunswick, at a cost of $2,093,662.05. It was modified in 1881, pursuant to the river and harbor act of that year, by adding to it the dredging of the south channel, about 13,000 feet long, 100 feet wide, and 5½ feet deep at mean low water, from Kearney Dock to Crab Island.

Under this project $577,366.27 had been expended June 30, 1893, in constructing the dikes required by the project at "The Stakes" and "Middle Grounds," in dredging channels 200 feet wide and 12 feet deep at mean low water at these points, in drilling, blasting, and dredging a channel of the same dimensions across the rocky shoals at Whitehead Sand Dock, and thence up the river, with a width of 100 feet and depth of 10 feet, to within 1,880 feet of New Brunswick, and the channel to Acken Dock redredged to a mean low-water depth of 6 feet and width of 50 feet from Raritan River to Acken Wharf, a distance of about 600 feet. Under two special allotments made for it in the acts of March 3, 1881, and August 2, 1882, the south channel was dredged to the required depth for a distance of 4,000 feet. These improvements had been of decided benefit to navigation. The commerce of the river was reported in 1887 at 1,675,355 tons, valued at $28,119,173; in 1890 at 1,661,425 tons, valued at $29,877,365; in 1891, 1,566,888 tons, valued at $31,031,299; in 1892 at 1,120,302 tons, valued at $27,694,017; and during the past year it is reported to be 1,446,658 tons, valued at $27,625,979.

Operations with the United States dredging plant belonging to this district, consisting of dredge, tugboat, and three dump scows, were continued to December 6, 1893, at which date the formation of ice in the river compelled a cessation of operations for the season and the placing of the plant in winter quarters at Perth Amboy, N. J., under guard of the necessary watchmen until operations could be resumed in the spring. During the working season, April 10 to December 6, 1893, the total amount of material dredged was 10,337 cubic yards, 8,142 cubic yards being blasted shale rock and 2,195 cubic yards sand and gravel. Of the material removed, 6,162 cubic yards of shale rock has been utilized in the partial construction of about 1,600 linear feet of Dike C, at the Middle Grounds, which it is proposed to construct with material dredged from the river to a length of 3,260 feet; the remainder was deposited behind Dike C. Ninety-one surface blasts, aggregating 21,950 pounds of XX Forcite powder, were necessary to accomplish these results.

As a result of the season's work the channel was prolonged 400 feet, with a depth of 10 feet mean low water and width of 100 feet, giving a channel of the required depth with a width of not less than 100 feet to within 1,500 feet of the canal lock at New Brunswick. Slight necessary repairs to the timber dikes were also made during the season. The accompanying maps will show the condition of the improved section, and also the original state of the river bottom.

Several of the residents of the town of New Brunswick made complaint during the past season of damage done their property by vibration caused by the surface blasting, and anticipating more serious opposition should this method of operation be continued during the coming season, it was thought desirable to discontinue the use of explosives in breaking up the rock and employ a rock-chiseling machine belonging to P. Sanford Ross, of Jersey City, which had previously been used in breaking rock on the Hudson River improvements under contracts with the United States. Authority for its employment for a period of from one to two months as a test of this method on the Raritan, at the rate of $1.25 per ton of rock broken free for dredging, was requested January 24, 1894, and granted January 25. A detailed description of this machine is given in the Annual Report of the Chief of Engineers for 1893, Part I, p. 1013.

This machine began work March 12, 1894, at a point in the river within 1,500 feet of the canal lock at New Brunswick, to which point the improved 100 feet wide channel had been carried by last season's work, and continued without interruption until April 13, working over a section 400 feet long and 60 feet wide, the penetration of the chisels being about 4 feet, breaking free for dredging 7,042 tons (estimated) of rock in twenty-seven working days.

Necessary repairs to the United States dredging plant in fitting it for the coming season's work were made between March 16 and April 14, 1894, at a cost of $1,949.09, of which about one-half is chargeable to this improvement, and the remainder to the appropriation for improving the channel between Staten Island and New Jersey, upon which the plant is to be employed at as early a date as practicable. The plant was towed from winter quarters at Perth Amboy, N. J., to the Raritan River on that date. Operations were resumed on the 18th, in clearing up sections Nos. 1, 2, and 3 of scattered shale rock left from last season. This work was completed on June 8, with a removal of 2,170 cubic yards. On June 9, the dredge began work on the section broken up by the chisel machine, and continued to the close of the fiscal year, removing 4,697 tons.

The material dredged from sections 1, 2, and 3 was used in the construction of Dike C at the Middle Grounds, and that broken by the chisel machine was utilized in paving the face of the embankment of the dike in Newark Bay, N. J.

The following tabular statement gives the amount and cost of work done by the United States dredging plant during the fiscal year:

Months.	Actual time.		Amount of material dredged and deposited.	Average amount dredged per actual working day.	Operating expenses, including maintenance while idle, and repairs.	Cost of dredging and depositing, per cubic yard.	Cost per cubic yard, including interest on original cost of plant.*
	Worked.	Lost.					
1893.	*Days.*	*Days.*	*Cu. yds.*	*Cu. yds.*			
July	18½	6½	1,177	63.62	$2,150.06	$1.827	$1.953
August	21⅝	5⅜	1,183	54.70	2,027.74	1.714	1.84
September	17½	8½	976	55.77	2,046.49	2.097	2.249
October	22½	3½	1,209	53.75	2,067.47	1.71	1.833
November	19	7	1,128	59.37	1,497.86	1.328	1.46
December	3	22	145	48.33	604.22	4.167	5.194
1894.							
January		26			145.00		
February		23			150.20		
March		26			495.54		
April	8½	16½	147	17.30	1,100.16	7.484	8.497
May	15¼	10¾	1,505	98.70	1,498.40	0.996	1.095
June	22¾	3¼	3,406	149.82	7,197.16	2.113	2.157
Totals and averages.	148⅝	158⅜	10,876	73.18	†20,980.30	1.929	2.093

* Interest computed at 4 per cent.

† Includes cost of breaking free for dredging.

Additional details will be given below by Assistant Engineer C. S. Kelsey, in local oversight of the work.

The expenditures during the fiscal year amount to $23,482.77, as follows:

Cost of removal and disposal of material	$18,663.78
Cost of repairs to timber dikes	481.63
Cost of inspection	2,366.75
Cost of drafting	300.00
Cost of administration	1,670.61
Total	23,482.77

The amount which can be expended profitably, as regards the efficient prosecution of the work, during the fiscal year ending June 30, 1896, is $100,000, and if appropriated will be expended in carrying the improved channel further up the river toward New Brunswick.

This work is in the collection district of Perth Amboy, which is the nearest port of entry. Nearest light-house, Great Beds Light, in Raritan Bay; nearest fort, fort at Sandy Hook, New Jersey.

Amount of revenue collected at the port of Perth Amboy during the fiscal year ending June 30, 1894, $———.

AMOUNTS APPROPRIATED.

By act of—		By act of—	
June 18, 1878	$200,000.00	August 11, 1888	$50,000.00
March 3, 1879	60,000.00	September 19, 1890	50,000.00
June 14, 1880	100,000.00	July 13, 1892	40,000.00
March 3, 1881	25,000.00		
August 2, 1882	25,000.00	Total	611,250.00
July 5, 1884	35,000.00	Amount expended	600,849.04
August 5, 1886	26,250.00		

Money statement.

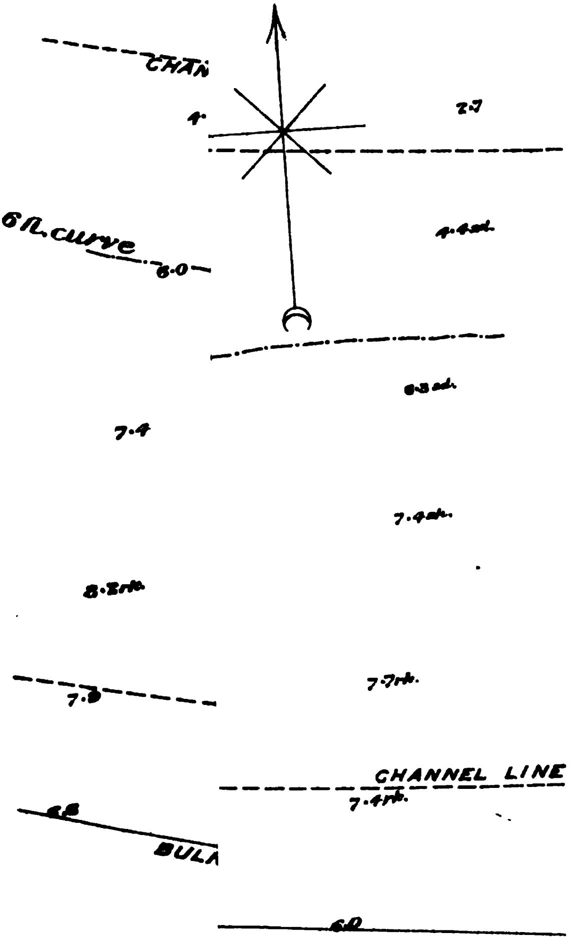
July 1, 1893, balance unexpended	$33,883.73
June 30, 1894, amount expended during fiscal year	23,482.77
July 1, 1894, balance unexpended	10,400.96
July 1, 1894, outstanding liabilities	8,885.10
July 1, 1894, balance available	1,515.86

No 1.

.J.

S.A.

SECTICO DREDGING



TO ACCOMPANY AN

ctfully submitted:

Thos. L. Casey

Capt. of Engrs. U.S.A.

F... Friedenwald Co., Photo Lith Balto. Md

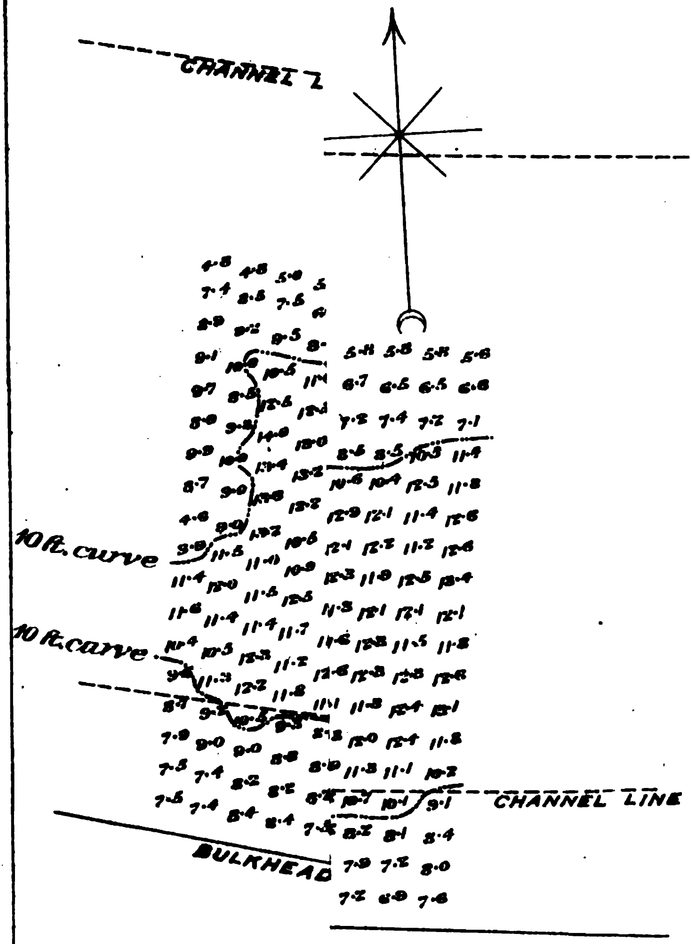
Eng. 58 3.

No. 2

I. J.

S.A.

SECTION OF TO DREDGING



tfully submitted:

TO ACCOMPANY ANNUAL R

Thos. L. Casey
Capt. of Engrs. U.S.A.

Amount (estimated) required for completion of existing project	$1,482,412.05
Amount that can be profitably expended in fiscal year ending June 30, 1896	100,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

REPORT OF MR. C. S. KELSEY, ASSISTANT ENGINEER.

NEW YORK, *June 30, 1894.*

CAPTAIN: The projected channel of the Raritan River at the site of recent operations is defined by curving boundary lines. For convenience in construction, the work is executed in rectilinear sections of 400 feet each. Two of these sections had been excavated through shale rock to the desired depth, 10 feet at mean low water, and over a width of 100 feet; a third section, begun on April 28, 1893, was under way at the beginning of the fiscal year. The methods then employed in breaking, lifting, and disposing of the rock, described in the report of last year, were continued throughout the work on this section, completed June 7, 1894.

Blasting was discontinued on November 1, 1893, when the rock had been broken below the required depth over the entire section, 400 feet by 100 feet, and 65 per cent of the cube removed; the balance remained scattered over the section, the dipper pushing a large percentage into adjoining cuts as the work progressed. The section for one-half its width had been redredged for loose rock at the close of the working season. A dipper dredge is ill-suited for picking up scattered rock and much time has been necessarily expended in this work, both in keeping a channel clear for passing traffic while the section was in process of excavation, and again, after it was apparently completed, in finishing the work, materially increasing the cost per cubic yard per finished section.

When operations were resumed in the spring the experiment was made of adapting the dredge to work either dipper or grapple, as the varying nature of the work required. No changes in the machinery of the dredge were made, except the addition of a foot brake to the backing drum and an additional sheave in the boom. The backing chain was carried from the outboard sheave up over the boom and the hauling chain reduced to one part. A four-leaf Cushing bucket was readily operated in this way and was worked for twelve days on sections 1, 2, and 3, removing from an area of 67,500 square feet 130 cubic yards of scattered rock that could not be secured with the dipper. The bucket when tried in a heavy bank of loose rock proved inefficient. The multiple-leaf bucket is not desirable for this work, but the experiment shows that the addition of a skeleton grapple or bucket of the clamshell type to the equipment of the plant would enable the channel to be completely cleared of loose blocks which can not be done with the present plant, and would reduce the total cost of the work.

The third section was completed June 7, 1894. The average depth over this area, 400 by 100 feet, after the rock was cleared of overlying gravel, was 8.2 feet. Cross sections 10 feet apart, made after completion of the work, a map of which is transmitted with this report, gives an average depth of 11.4 feet at mean low water. There were no shoal soundings. The amount of rock removed was 5,598 cubic yards in place, estimated in scows at 9,614 cubic yards, and measured by water displacement at 13,181 tons net, equivalent to 5,990 cubic yards in place, estimating the rock at 163 pounds per cubic foot. The cost of this work, including operating, repairs, additions, maintenance, local superintendence, and exclusive of office expenses and interest, was as follows:

Explosive, 4 lbs. per cubic yard at 18¼ c	$0.73
Dredging	1.75
Towing	.65
Delivering in construction of Dike C	.45
Total, per cubic yard in place	3.58

Total for breaking and dredging, $2.48 per yard or $1.13 per ton.

Comparative table, sections 1, 2, and 3.

Section.	Time of work.	Explosives.	Rock removed, (cubic yards in place).	Cost per cubic yard for breaking, dredging, and towing.
	Months.	*Pounds.*		
1	9⅛	4,856	2,962	$3.88
2	11¼	18,750	3,911	3.84
3	12⅛	21,880	5,598	3.13

The character of the rock encountered in the advancement of the channel of the Raritan River since 1891 was well adapted to the percussion method of rock breaking, but the reduced appropriation of 1892 would not warrant the additional plant. In March last an opportunity offered for making trial of this method. In 1893 a rock-breaker was built by Mr. P. S. Ross for work on the Hudson River, under contract with the U. S. Government. This machine has been worked upon the Raritan River rock for five weeks, under an agreement to pay $1.25 per ton for rock broken free for dredging, and has demonstrated the cheapness with which the rock excavation can be carried on under this system. In the brief time of five weeks the rock over an area of 400 feet by 60 feet was broken down an average of 3.4 feet, estimated at 325 tons per day of ten hours work. The cost to the contractor for running expenses and repairs on this work did not exceed 15 cents per ton. A description of this rock-breaker is given on page 1013 of the report of the Chief of Engineers for 1893. A photograph of the machine accompanies this report.

The machine was operated on this work to swing in arcs spaced from 1.5 feet to 2.5 feet apart. The blows were struck with the boat stationary, and the points of attack were spaced along the arc of swing about 2 feet apart. Excess of spacing between the arcs was detected by accurately established cross-ranges, the position of the boat being determined each time the chisels came to the center of the arc. The spacing along the arc was not readily checked, and variations here account no doubt for the wide range in the size of broken stone. While the bulk of the material is fine, or stone easily handled by one man, blocks up to the size of a cubic yard are numerous. From three to fifteen blows with each chisel, weighing 6 tons and falling from 15 to 25 feet, were sufficient to gain the penetration of 4 feet. Beginning at the extreme end of arc, after advancing the boat, the rock is unbroken around the chisel, but at the first shift the broken stone on one side and in front so diminishes the resistance that one-third the number of blows would usually suffice. The rock was found to be broken finer in the center than on the sides, due to the increasing distance between arcs from the center out. The breaking of the rock increased its bulk 25 per cent, shoaling the depth by 1 foot, and increasing the difficulties of providing for the daily traffic. The time of work did not suffice to determine the rate of wear on the chisel points, or the permanent angle in this rock. The chisels had been used on the Hudson River and had worn to an angle of less than 30 degrees. No change was noted while on this work.

The dredge began the work of removal June 8, and at the close of the year had taken up 4,697 tons, an average of 235 tons per day.

The chisels had been worked to a penetration of 1 foot below the required depth. After dredging, the depth was found to be in most places within 0.5 feet of the penetration of the chisels, and no shoal points have as yet been found. The adoption of this method for future work should result in a large reduction in cost, either by advantageous contract or by equipment of plant; in a gain in the rate of progress; in a saving of time, allowing the use of the plant on other works; in a reduction in wear and tear on machinery, and the abatement of the nuisance of blasting.

During the year 6,743 cubic yards of rock removed from the channel has been used in the construction of dike C, making a total of 8,014 cubic yards placed in the dike, and building 1,680 linear feet of riprap dike (including 906 feet of old embankment partially constructed) at a cost of $2,470.30. A small amount of dredged rock has been used in refilling timber dikes in the Raritan and Shrewsbury rivers, and 2,032 cubic yards have been sent to Newark Bay for revetment. During the year 1,091 linear feet of waling on the timber dikes was renewed at a cost of 68 cents per foot.

Respectfully submitted.

C. S. KELSEY,
Assistant Engineer.

Capt. THOS. L. CASEY,
Corps of Engineers, U. S.

COMMERCIAL STATISTICS.

The following statistics relative to to the commerce of Raritan River, New Jersey, during the year ending December 31, 1893, were compiled from statements furnished by parties making shipments over this waterway:

Articles.	Amount.	Value.	Vessels.	Number.	Average draft.	Average tonnage.
	Tons.				*Feet.*	*Tons.*
Building material	879,533	$3,474,515	Steam	2,752	8½	135
Coal	287,243	1,484,413	Sail	954	7½	97
Iron and ores	31,330	939,900	Barges	1,914	6½	113
Fertilizer	5,294	11,302	Rafts	181		
Miscellaneous	243,258	21,715,850				
Total	1,446,658	27,625,979		5,801		

The above table shows an increase of 326,356 tons over amount reported for year 1892.

F 10.

IMPROVEMENT OF SOUTH RIVER, NEW JERSEY.

Before the improvement of this stream was undertaken by the United States the navigation of the lower 2½ miles of its course had been abandoned and a canal dredged at private expense from a short distance below Washington to Sayreville on the Raritan River. In 1880 the mouth of this canal had shoaled to a depth of 6.4 feet at mean low water, and the best depth in the canal, some distance above, had decreased to 3.3 feet. Above Washington a depth of 2.7 feet existed to Bissetts, 3⅝ miles, and 2.5 feet to Old bridge, the head of navigation, 6¼ miles above the mouth of the canal at Sayreville. The range of the tide was 5.3 feet at Sayreville.

The project adopted in 1880 provided for closing the river below the head of the canal, correcting the direction of the mouth of the latter, and obtaining, by diking and dredging, a depth of 8 feet mean low water to Washington, 6 feet to Bissetts, and 4 feet to Old bridge, straightening the channel at two points by cutting across the meadow, estimated to cost $194,695. This was modified July 30, 1892, by omitting the proposed dredging of the cut-off above Washington and in front of the brickyards; the construction of dikes H, I, J, K, and L, and substituting therefor the dredging of the section of the river between Washington and the Raritan River railroad bridge, reducing the original estimate to $176,795.

The amount expended to June 30, 1893, was $76,038.97, with which the direction of the mouth of the canal has been changed; the dikes below Washington completed and maintained; a small amount of dredging done on a shoal above Washington; a shoal at the mouth of Washington Canal removed, and a channel dredged 60 feet wide through the canal and 50 feet wide across the shoal in the river below Washington; the channel between the Turnpike bridge and Raritan River railroad bridge dredged 50 to 100 feet wide and 6 feet deep, mean low water; and the channel for a distance of 350 feet above the bridge dredged to 4 feet, mean low water, and width of 70 feet. At Rourke Reach the channel was given a depth of 6 feet at mean low water and width of 60 feet for a distance of 860 feet; in addition a bar opposite Whitehead's brickyard was removed to a depth of 8 feet at mean low water and width of 60 feet for a distance of 450 feet, and at the junction of the canal and South River a channel was excavated 350 feet long, 60 feet wide, and 6 feet deep at the same stage of the tide.

The balance of the funds available for the fiscal year ending June 30, 1894, would not admit of active operations and so no work was attempted during the past year; the expenditures, amounting to $1,000.77, have been for office work and examinations.

The present condition of this improvement is such that the river can be navigated by vessels of 6 feet draft at all stages of the tide for a distance of about 3 miles above its mouth.

The sum of $10,000 can be expended profitably as regards the efficient prosecution of the work during the fiscal year ending June 30, 1896. It would be applied to giving the channel the full dimensions required by the project.

This work is in the collection district of Perth Amboy, which is the nearest port of entry; nearest light-house, Great Beds Light, in Raritan Bay, New Jersey; nearest fort, fort at Sandy Hook, N. J.

Amount of revenue collected at the port of Perth Amboy during the fiscal year ending June 30, 1894, ———.

AMOUNTS APPROPRIATED.

By act of Congress approved—	
June 14, 1880	$40,000.00
March 3, 1881	6,000.00
August 2, 1882	10,000.00
August 5, 1886	5,000.00
August 11, 1888	5,000.00
September 19, 1890	5,000.00
July 13, 1892	7,000.00
Total	78,000.00
Amount expended	77,039.74

Money statement.

July 1, 1893, balance unexpended	$1,961.03
June 30, 1894, amount expended during fiscal year	1,000.77
July 1, 1894, balance unexpended	960.26
Amount (estimated) required for completion of existing project	98,795.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	10,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

COMMERCIAL STATISTICS.

The following statistics relative to the commerce of South River, New Jersey, were furnished by Mr. E. A. Fisher, of Sayreville, N. J., for the year ending December 31, 1893:

Articles.	Amount.	Value.	Vessels.	Number.	Average draft.	Average tonnage.
	Tons.				*Feet.*	*Tons.*
Building material	130,260	$260,520	Sail	1,405	6	67
Clay	4,500	9,000	Barges	258	6	115
Coal	9,000	36,000				
Fertilizer	10,500	15,750				
Miscellaneous	2,000	5,000				
Total	156,260	326,270		1,663		

The above table shows a decrease of 6,202 tons when compared with amount reported for calendar year 1892.

F II.

IMPROVEMENT OF KEYPORT HARBOR, NEW JERSEY

Keyport Harbor was originally accessible at low water only to vessels drawing less than 4 feet. Before its improvement was undertaken by the United States a 6-foot channel had been dredged at private expense, which had shoaled in 1872 to 5½ feet and in 1882 to 5 feet, the range of the tide being 4.7 feet. A large commerce was carried on, however, valued at $2,932,000.

The project for the improvement was adopted in 1873, and provides for dredging a channel 4,700 feet long, 8 feet deep at mean low water, and 200 feet wide from the steamboat dock to the 8-foot contour in Raritan Bay, at an estimated cost of $30,475. No money was appropriated for this purpose, however, until August 2, 1882. A subsequent survey showed that material shoaling had taken place in the channel since 1872, the date of the original survey, necessitating an increase of the original estimate to $40,475.

The amount expended on this improvement to June 30, 1893, was $35,389.32, with which (in 1883) a channel had been dredged to the required depth from the 8-foot contour in Raritan Bay to Keyport Wharf, a distance of 5,000 feet, with a width of 200 feet for the first 4,200 feet and 160 for the remainder. This channel did not prove permanent, however, having deteriorated to a width of 30 to 50 feet and mean low-water depth of 6 to 7 feet. It was redredged in 1893 to the projected mean low water depth, with widths of from 70 to 140 feet in front of Keyport Wharf for a distance of 400 feet; for a further distance of 2,200 feet outward a cut 35 feet wide was made along the northerly side of the old channel.

No active operations have been in progress on this improvement during the present fiscal year, the unexpended balance ($85.68) from appropriation of 1892 being insufficient.

The expenditures during the fiscal year amount to $2.20 for office expenses.

The balance of the estimate ($5,000) can be profitably expended during the fiscal year ending June 30, 1896.

This work is in the collection district of Perth Amboy, N. J., which is the nearest port of entry. Nearest light-house, Great Beds Light, in Raritan Bay; nearest fort, fort at Sandy Hook, N. J.

Amount of revenue collected at the port of Perth Amboy during the fiscal year ending June 30, 1894, $———.

AMOUNTS APPROPRIATED.

By act of—	
August 2, 1882	$30,475.00
July 13, 1892	5,000.00
Total	35,475.00
Amount expended	35,391.52

Money statement.

July 1, 1893, balance unexpended	$85.68
June 30, 1894, amount expended during fiscal year	2.20
July 1, 1894, balance unexpended	83.48
Amount (estimated) required for completion of existing project	5,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	5,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

F 12.

IMPROVEMENT OF MATTAWAN CREEK, NEW JERSEY.

Before its improvement by the Government this small stream was obstructed at its entrance into Keyport Harbor by a mud flat, on which the best depth at the worst section was 3.1 feet at mean low water, though the 3-foot channel was too narrow and tortuous for use. Above this flat a good 4-foot channel existed to 1⅛ miles above the mouth, and thence to the steamboat dock at Mattawan 3.5 feet, shoaling to 1.8 feet at the freight dock 600 feet above and 1⅞ miles from the mouth. The range of the tide is 4.7 feet. Notwithstanding the above difficulties it carried commerce valued in 1880 at $800,000. In 1885 the commerce of the creek was stated to be 130,000 tons, valued at $2,000,000.

The project for this improvement was adopted in 1881, and provides for dredging a channel 4 feet deep at mean low water and 100 feet wide from the mouth to Winkson Creek, and thence 75 feet wide to the railroad bridge at Mattawan, 250 feet above the freight dock, at an estimated cost of $33,120.

Appropriations were made for this improvement to the close of the fiscal year ending June 30, 1892, as follows: March 3, 1881, $15,000; August 2, 1882, $6,000, and September 19, 1890, $2,500. With the appropriations of 1881 and 1882 the channels had been dredged to the required depth from the mouth to the freight dock at Mattawan, with widths of from 100 to 30 feet. The small appropriation of 1890 enlarged the dimensions of the channel through the flat outside the creek nearly to the requirements of the project, and also for a distance of 1,420 feet upstream from its mouth.

The river and harbor act of July 13, 1892, appropriated $9,620 for completing the improvement, and a project for its expenditure in dredging the channels to the full dimensions was approved July 27, 1892. A survey of this stream, begun October 24 and completed November 3, 1892, showed that the channels dredged in 1881 and 1882 had almost reverted to their original condition, and that the amount of work required to complete the project could not be performed with the available funds; consequently a revised estimate for completing the project, increasing the original by $10,000, was submitted for the approval of the Chief of Engineers May 29, 1893.

Dredging operations, under contract dated May 3, 1893, with Alonzo E. Smith (detailed in Annual Report for 1893, p. 1126), in progress at the close of the last fiscal year, were continued to September 22, 1893, at which date the contract was concluded, 24,902 cubic yards of material having been removed, of which 22,285 cubic yards were removed during the present fiscal year.

Under this contract the channel between the mouth of the creek and steamboat wharf at Keyport was redredged on its southerly side to a mean low-water depth of 4½ feet for a distance of 2,100 feet upstream from Keyport Wharf, and given a width of 50 feet for the first 1,500 feet, with 25 feet for the remainder, and on its northerly side redredged to a similar depth with a width of 25 feet for a distance of 630 feet extending from Keyport Wharf upstream. From about 500 feet above Winkson Creek to the steamboat dock at Mattawan, a distance of about 4,000 feet, the channel was redredged to a width of 50 feet and mean low-water depths of from 4 to 5 feet.

The expenditures during the fiscal year ending June 30, 1894, amount to $8,752.06, as follows:

Dredging under contract	$7,470.60
Inspection	533.00
Drafting	225.00
Administration	523.46
Total	8,752.06

If it is the intention of Congress to continue the work $10,000 can be profitably expended during the fiscal year ending June 30, 1896.

This work is in the collection district of Perth Amboy, which is the nearest port of entry. Nearest light-house, Great Beds Light, in Raritan Bay. Nearest fort, fort at Sandy Hook, N. J.

Amount of revenue collected at the port of Perth Amboy during the fiscal year ending June 30, 1894, $———.

AMOUNTS APPROPRIATED.

By act of—	
March 3, 1881	$15,000.00
August 2, 1882	6,000.00
September 19, 1890	2,500.00
July 13, 1892	9,620.00
Total	33,120.00
Amount expended	32,873.64

Money statement.

July 1, 1893, balance unexpended	$8,998.42
June 30, 1894, amount expended during fiscal year	8,752.06
July 1, 1894, balance unexpended	246.36
Amount that can be profitably expended in fiscal year ending June 30, 1896 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	10,000.00

COMMERCIAL STATISTICS.

The following statistics relative to the commerce of Mattawan Creek, New Jersey, during the year ended December 31, 1893, were furnished by Mr. J. W. Maggs, of Matawan, N. J.

Articles.	Amount.	Value.	Vessels.	Number.	Average. draft.	Average tonnage.
	Tons.				*Feet.*	*Tons.*
Produce	100,000	$2,500,000	Steam	2	6½	228
Brick	162,000	575,000	Sail	25	6½	75
Fertilizer	300,000	100,000	Barges	100	6½	100
Lumber	10,000	12,000				
Coal and wood	5,000	7,000				
Sundries	1,700	50,000				
Total	578,700	3,244,000		127		

The above table shows an increase of 252,200 tons over amount reported for calendar year 1892.

F 13.

IMPROVEMENT OF SHOAL HARBOR AND COMPTON CREEK, NEW JERSEY.

Shoal Harbor is situated on the south side of Sandy Hook Bay, 5 miles west of the entrance to Shrewsbury River, New Jersey. The harbor is formed by a slight indentation in the shore line where Compton Creek empties into the bay. The outer harbor is unprotected by projecting headlands or other natural topographical features. The creek is used principally as a harbor for small vessels engaged in the fish and oyster trade, and contains ample depth of water for this purpose, except at the entrance, which nearly runs dry at low water, thus preventing vessels from entering excepting at or near high water.

At a point about one-fourth of a mile above its mouth the creek is crossed by a fixed bridge without a draw, beyond which no vessels ever go. The village of Port Monmouth, located on the left shore of the harbor, is the principal shipping point for garden truck from the adjacent farming districts and for fish and oysters taken in the bay.

The plan of improvement adopted in 1884 had in view the connection of the 5-foot mean low-water curve of the creek, on the inside, with the 5-foot curve of the bay by means of a dredged channel 150 feet wide, and the protection of this channel against shoaling by means of a timber dike placed on the west side of the harbor, at a total estimated cost of $64,130.

The first appropriation was made in the act of September 19, 1890, the wording being as follows: "Improving Shoal Harbor and Compton Creek, New Jersey, so as to give a channel 4 feet deep at mean low water, $5,000."

The total expenditure on this improvement to June 30, 1893, was $5,139.29, with which amount the channel was dredged in 1891 to a mean low-water depth of 4½ feet for a distance of 1,200 feet, beginning near the bulkhead at the mouth of the creek, with a width of 100 feet for the first 800 feet and 70 feet for the remainder. A survey was made in October, 1892, from the mouth of the creek, extending through Shoal Harbor toward the bay, for a distance of about 4,000 feet. This survey showed that the improved channel had contracted to widths of from 60 to 80 feet, with mean low-water depths of from 3.2 to 4.2 feet.

An appropriation of $3,000 for continuing the improvement was made in the act of July 13, 1892, and a project for its expenditure in extending the dredged channel toward the deep water in Raritan Bay as far as the funds available will permit, maintaining the width of 75 feet and depth of 4 feet mean low water, was approved July 26, 1892. Specifications were prepared and sealed proposals invited by advertisement, but no bids were received at the date of opening, March 29, 1893, and it was subsequently recommended that the work be left in abeyance until such time as an advantageous offer might be obtained to do the work with hired plant.

The approval of the Chief of Engineers was obtained March 20, 1894, for the expenditure of the available appropriation in continuing the improvement by hiring plant to do the work in open market as the method most economical and advantageous to the Government. In pursuance of this authority circular letters inviting proposals were issued March 22 to dredging contractors in Albany, New York City, and Jersey City, and the following responded:

		Cents.
Brainard Bros., New York, N. Y.	per cubic yard	69¼
William H. Taylor, Jersey City, N. J.	do	54

The bid of William H. Taylor, being considered reasonable, was duly recommended, and its acceptance was authorized April 9, 1894.

Operations will be begun upon the completion of work on the Elizabeth River, as both these works have been awarded to William H. Taylor, of Jersey City, N. J.

There have been no expenditures on this improvement during the fiscal year, as no work has been done.

The sum of $8,000 can be profitably expended in further extending and deepening this channel to the 5 feet required by the project.

This work is in the collection district of Perth Amboy, which is the nearest port of entry; nearest light-house, Navesink Light, and nearest fort, fort at Sandy Hook, N. J.

Amount of revenue collected at the port of Perth Amboy during the fiscal year ending June 30, 1894, $———.

AMOUNTS APPROPRIATED.

By act of—	
September 19, 1890	$5,000.00
July 13, 1892	3,000.00
Total	8,000.00
Amount expended	5,139.29

Money statement.

July 1, 1893, balance unexpended	$2,860.71
July 1, 1894, balance unexpended	2,860.71
Amount (estimated) required for completion of existing project	56,130.00
Amount that can be profitably expended in fiscal year ending June 30, 1896	8,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.	

COMMERCIAL STATISTICS.

The following statistics relative to the commerce of Shoal Harbor and Compton Creek, New Jersey, during the year ending December 31, 1893, were furnished by Capt. Benjamin Griggs, of Port Monmouth, N. J.:

Articles.	Amount.	Value.	Vessels.	Number.	Average draft.	Average tonnage.
	Tons.				*Feet.*	*Tons.*
Farm produce	38,000	$135,000	Steam	1	4	496
Clams and fish	12,000	28,000	Sail	150	2	20
Fertilizer	12,000	18,000				
Coal	3,500	12,000				
Miscellaneous	4,000	40,000				
Total	69,500	233,000		151		

The above table shows an increase of 7,500 tons over that reported for year 1892.

F 14.

IMPROVEMENT OF SHREWSBURY RIVER, NEW JERSEY.

In its original condition this river was much obstructed by sand bars, on which the best depths at mean low water were, at the mouth, 3.9 feet; below Highlands bridge, 5.4 feet; at Lower Rocky Point, 3.6 feet;

at Barley Point, 3.3 feet; at Chalmers, 5 feet; at Oceanic, 5.5 feet; below Bellevue, 3.1 feet; at Sea Bright, 4.2 feet; at Jumping Point, 2.6 feet; and at Sedge Island, 2.8 feet.

The project for this improvement was adopted in 1879, and contemplates the formation of a channel 6 feet deep at mean low water and from 300 to 150 feet in width from the mouth of the river to Red Bank, on the North Branch, 8 miles, and to Branchport, on the South Branch, 9 miles, at an estimated cost of $254,562.

The total amount expended on this improvement to June 30, 1893, was $227,646.55, with which numerous dikes have been built and maintained and channels dredged and redredged in various parts of both branches of the river.

At the close of the summer of 1893 there was a small balance remaining from the appropriation of $10,000, made in the river and harbor act of July 13, 1892, and the authority of the Chief of Engineers was obtained March 20, 1893, to expend these funds, amounting to about $1,400, in opening the navigable channels which had been partially filled with sand during last winter. The method of doing this by hire of plant in open market was approved as being most economical and advantageous to the Government.

Pursuant to this authority circular letters inviting proposals were issued March 22 to the principal dredging contractors in New York, Albany, and Jersey City, and the following responded:

Name and address of contractor.	Per cubic yard.	
	North Branch.	South Branch.
	Cents.	*Cents.*
Brainard Bros., New York, N. Y	19⅛	49⅛
J. P. Randerson, Albany, N. Y	35	45
Wm. H. Taylor, Jersey City, N. J	39	46
Edgar M. Payn, Albany, N. Y	45	75

The lowest bid received was that of Brainard Bros., which, being considered reasonable, was recommended for acceptance, and was approved April 9, 1894. Operations were begun April 24, in the removal of a bar in the channel of the North Branch above Upper Rocky Point to a mean low-water depth of 7 feet and width of 150 feet for a distance of 140 feet, this being completed May 12 by the excavation of 3,000 cubic yards of material. The plant was towed to the South Branch May 14, and began work on a bar in the bend of the channel opposite Dike J, that projected into the channel on its western side, removing it by parallel cuts to a depth of 7 feet mean low water and width of 75 feet for a distance of about 280 feet, completing its removal May 28, with an excavation of 1,200 cubic yards of material.

The work accomplished during the latter part of the summer of 1893 consisted principally in repairs to several dikes, especially that at the mouth of the main river, which urgently needed renewal in many places. On November 11, 1893, a report was made concerning the protection of the line of beach connecting Sandy Hook with the mainland. The steamboat men navigating the South Branch made complaints from time to time in regard to a wharf projecting into the channel at the sharp bend near Sea Bright, and a hearing on the question of fixing harbor lines in this locality was held in January. A report on the subject was rendered January 26, 1894, and the pier and bulkhead lines were permanently fixed by the Secretary of War on February 5, 1894.

The present condition of the channels is satisfactory in the main, but considerable changes seem to be in progress in the parts of the channel immediately above Upper Rocky Point and near Oceanic.

The expenditures during the fiscal year amount to $6,776.55, as follows:

Dredging (contract completed June 30, 1893)	$3, 299. 22
Dredging (by hired plant April and May, 1894)	1, 190. 25
Repairs to dikes	1, 918. 79
Inspection	335. 00
Administration	33. 29
Total	6, 776. 55

This work is in the collection district of Perth Amboy, which is the nearest port of entry; nearest light-house, Navesink Light; nearest fort, fort at Sandy Hook, N. J.

Amount of revenue collected at the port of Perth Amboy during the fiscal year ending June 30, 1894, is: $——.

AMOUNTS APPROPRIATED.

Old project.

By act of—	
August 30, 1852 (survey)	$1, 500. 00
March 3, 1871 (dredging)	14, 000. 00
March 3, 1873 (dredging)	5, 000. 00
Total	20, 500. 00

Existing project.

By act of—	
June 18, 1878 (diking)	$18, 000. 00
March 3, 1879	10, 000. 00
June 14, 1880	30, 000. 00
March 3, 1881	86, 000. 00
August 2, 1882 (dredging)	30, 000. 00
August 5, 1886 (diking)	10, 000. 00
August 11, 1888	10, 000. 00
September 19, 1890	10, 000. 00
July 13, 1892	10, 000. 00
Total	214, 000. 00
Grand total	234, 500. 00
Amount expended	234, 423. 10

Money statement.

July 1, 1893, balance unexpended	$6, 853. 45
June 30, 1894, amount expended during fiscal year	6, 776. 55
July 1, 1894, balance unexpended	76. 90
July 1, 1894, outstanding liabilities	9. 00
July 1, 1894, balance available	67. 90
Amount (estimated) required for completion of existing project	20, 062. 00
Amount that can be profitably expended in fiscal year ending June 30, 1896	20, 062. 00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.

COMMERCIAL STATISTICS.

The following statistics relative to the commerce of Shrewsbury River, New Jersey, during the year ending December 31, 1893, were furnished by Capt. James S. Throckmorton, of Red Bank, N. J.:

Articles.	Amount.	Value.	Vessels.	Number.	Average draft.	Average tonnage.
	Tons.				*Feet.*	*Tons.*
Produce	225,000	$2,015,000	Steam	56	4½	350
Oysters and fish	16,000	850,000	Sail	80	3	25
Fertilizers	70,000	490,000	Barges	30	4	25
Coal	100,000	400,000	Rafts	10		
Lumber	1,000	20,000				
Miscellaneous	325,000	3,250,000				
Total	737,000	7,025,000		176		

The above table shows an increase of 65,000 tons over that reported for year 1892.

Two new transportation lines were established on the South Branch during the fiscal year ending June 30, 1894.

F 15.

IMPROVEMENT OF MANASQUAN (SQUAN) RIVER, NEW JERSEY.

In its original condition this stream had a depth of from 4 to 6 feet at mean low water for several miles above its mouth, and was obstructed at its outlet into the ocean by a sand spit, which had deflected the stream into a channel parallel with the beach, communicating with the ocean across shifting sand bars, on which the best depth did not exceed 1½ feet at mean low water; mean range of tide, 2.4 feet. In severe storms this channel was sometimes entirely closed by sand.

The project for this improvement was adopted in 1879 and contemplated dredging the lower river and obtaining by means of jetties a permanent outlet nearly at right angles to the beach, with a depth of 6 feet at mean low water, at an estimated cost of $52,120. This was increased to $72,000 in 1882, the increase being due to advanced prices and to a proposed increase in the length of the jetties.

The amount expended under this project to June 30, 1887, was $39,000, with which two jetties had been constructed, but neither to its full length, appropriations having ceased in 1882. No permanent improvement had been effected.

A detailed account of this work was given in my report for 1891, p. 1010 *et seq.*

There were no expenditures on account of this work during the past fiscal year.

This work is in the collection district of Perth Amboy, N. J., which is the nearest port of entry. Nearest light-house, Great Beds Light, in Raritan Bay; nearest fort, fort at Sandy Hook, N. J.

Amount of revenue collected at the port of Perth Amboy during the fiscal year ending June 30, 1894, $——.

AMOUNTS APPROPRIATED.

By act of—

March 3, 1879	$12,000
June 14, 1880	20,000
August 2, 1882	7,000
September 19, 1890	2,000
Total	41,000
Amount expended	39,000

Money statement.

July 1, 1893, balance unexpended	$2,000
July 1, 1894, balance unexpended	2,000
Amount (estimated) required for completion of existing project	31,000

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

F 16.

REMOVING SUNKEN VESSELS OR CRAFT OBSTRUCTING OR ENDANGERING NAVIGATION.

Wrecks of three canal boats in the channel of Elizabeth River, New Jersey.—The owner of the above-mentioned wrecks, George A. Morrell, of Elizabeth, N. J., was notified December 23, 1893, that they were an obstruction to navigation, and was called upon to remove them.

On February 9, 1894, the matter was reported to the United States attorney for the district of New Jersey, with request that action be taken against the owner.

No action having been taken by the district attorney to compel their removal up to March 22, a report was made on that date to the Chief of Engineers recommending their removal by the United States, for which an allotment of $800 was requested; this was approved by the Secretary of War, March 26, 1894.

On April 3, 1894, open-market bids were received, as follows:

William H. Taylor, Jersey City, N. J	$350
James McSpirit, Jersey City, N. J	450
Edgar M. Payn, Albany, N. Y	400
John P. Randerson, Albany, N. Y	790

Authority for the acceptance of the lowest bid, that of William H. Taylor, was requested April 6 and granted April 7, 1894.

The wrecks were subsequently removed by the owner at his own expense, and this fact was reported to the Department June 19, 1894.

F 17.

ESTABLISHMENT OF HARBOR LINES IN SHREWSBURY RIVER, NEAR SEABRIGHT, NEW JERSEY.

NEW YORK AND LONG BRANCH STEAMBOAT COMPANY,
Long Branch City, N. J., October 9, 1893.

DEAR SIR: On behalf of the New York and Long Branch Steamboat Company I respectfully request that a survey be made and a bulkhead line established on the property lying between the Seabright drawbridge on the north and the Government dike on the south, in the waters of the South Shrewsbury River, New Jersey. The piers and docks, as now existing, are, in opinion of this company, an impediment and an obstruction under the law, and a serious menace to the free navigation of this river.

Yours, respectfully,

THOMAS PATTEN,
Treasurer.

Hon. D. S. LAMONT,
Secretary of War.

[Second indorsement.]

OFFICE CHIEF OF ENGINEERS,
U. S. ARMY,
October 11, 1893.

Respectfully referred to Capt. Thos. L. Casey, Corps of Engineers, for report.

If, in Capt. Casey's opinion, harbor lines should be established at this locality under provisions of section 12 of the river and harbor act of August 11, 1888, as amended and reenacted by section 12 of the river and harbor act approved September 19, 1890, he will please submit to this office a map showing the harbor lines which, in his judgment, should be established by the Secretary of War.

To be returned through the division engineer.

By command of Brig. Gen. Casey:

H. M. ADAMS,
Major, Corps of Engineers.

[Third indorsement.]

U. S. ENGINEER OFFICE,
New York, January 26, 1894.

Respectfully returned to the Chief of Engineers, U. S. Army, through the Division Engineer, Northeast Division.

On Tuesday, January 23, there was held in this office a meeting fully attended by all parties interested in the questions, direct and incidental, involved in this communication. The several interests were invited to give their opinions before a map compiled from recent surveys, and, in part, herewith inclosed* (marked "A"). Upon this map is marked in full the bulkhead lines, and, in broken line, the pier-head lines established by the board of riparian commissioners of the State of New Jersey in 1880.

It will be observed that the pier and bulkhead lines of the State of New Jersey at the bend opposite Seabright, although probably appropriate under the conditions existing at the time they were established, no longer serve the purpose for which they were intended. Since the dikes (shown in black) were built in 1881, this channel way has shifted to the eastward and the adjacent portions of the established harbor lines now lie in the deep-water channel of the river, the pier-head line being in fact about axial. The turn near the southern Rikers Dock is much too abrupt for safe navigation under certain conditions of wind and tide.

As a result of the conference I am of the opinion, therefore, that—

1. A rigid system of harbor lines in the Shrewsbury River is scarcely practicable at present, and can only be laid down effectively when the channels have been brought into an approximately permanent position by dikes either existing or to be hereafter constructed.
2. To relieve the present difficulty of the steamboats in making the turn at Seabright, I would recommend dredging off a portion of the bank forming the western side of the bend, putting in a dike marked O, and subsequently, if found necessary, building a cut-off dike marked P, replacing Dike L of the existing project, which latter dike was to be placed between Gunning Island and Jumping Point, as shown on the map.

The channel at and near the bend is at present maintained mainly by the ebb, the flood being divided, a considerable portion passing through the gap at Dike P. The free end of Dike O being unsupported and in deep water is necessitated by the demands of the people living south of Seabright, who state that they can not have their tidal circulation destroyed and their line of communication interrupted. The same complaint would come from the landowners if the dike marked P were to be attempted.

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*Not printed.

This leads finally to the greatest obstacle to the improvement of the Shrewsbury River from a commercial standpoint, viz, the antagonism of the people owning property along the shores, who make use of the river simply as a pleasure resort and whose interests are centered in the railroads and small sailing craft, to every form of commercial navigation. It does not seem possible to reconcile these opposing interests, but until it can be done our efforts to give the channels a fixed and permanent position by means of training dikes will be to a large extent abortive.

THOS. L. CASEY,
Captain, Corps of Engineers.

[Fourth indorsement.]

NORTHEAST DIVISION ENGINEER OFFICE,
New York, January 30, 1894.

Respectfully forwarded to the Chief of Engineers, U. S. Army.

While no actual extension of piers to the pier-head line established by the board of riparian commissioners of New Jersey in 1880 appears to have been made thus far, this could now be legally done at any time by the riparian proprietors, to the manifest detriment of navigation interests. I think therefore that the authority to make such extension should be withdrawn by the Secretary of War by establishing a pier and bulkhead line coincident with the present bulkhead line, as determined by the board of riparian commissioners of New Jersey between the Seabright drawbridge and the North or Government Dike. I also recommend that the outer 250 feet of the projected Dike O be omitted, at least for the present. In other respects I concur in the recommendations of Captain Casey.

HENRY L. ABBOT,
Colonel of Engineers, Bvt. Brig. Gen., U. S. A.,
Division Engineer.

[Fifth indorsement.]

OFFICE CHIEF OF ENGINEERS,
U. S. ARMY,
February 2, 1894.

Respectfully returned to the Secretary of War.

This is an application for establishment of harbor lines in Shrewsbury River, near Seabright, N. J.

Captain Casey, the officer in charge of the improvement of Shrewsbury River, submits in the third indorsement his views and recommendations, which are concurred in, in part, by the division engineer in fourth indorsement.

Colonel Abbot, the division engineer, states that while no actual extension of piers to the pier-head line established by the board of riparian commissioners of New Jersey in 1880 appears to have been made thus far, this could now be legally done at any time by the riparian proprietors to the manifest detriment of navigation interests. He thinks therefore that the authority to make such extension should be withdrawn by the Secretary of War by establishing a pier and bulkhead line coincident with the present bulkhead line, as determined by the board of riparian commissioners of New Jersey, between Seabright drawbridge and the North or Government Dike. He also recommends that the outer 250 feet of the projected Dike O be omitted, at least for the present.

The views of the division engineer are concurred in by me.

THOS. LINCOLN CASEY,
Brig. Gen., Chief of Engineers.

[Sixth indorsement.]

WAR DEPARTMENT, *February 5, 1894.*

Respectfully returned to the Chief of Engineers, with tracing, showing the bulkhead and pier-head line as established by the Secretary of War this date.

By order of the Secretary of War:

JOHN TWEEDALE,
Chief Clerk.

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